An End-Fed Center-Fed 20-Meter Portable Antenna | 30

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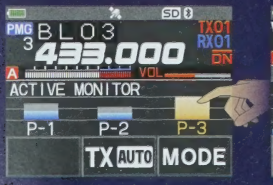
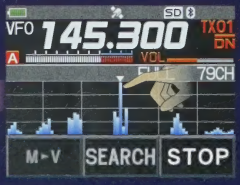
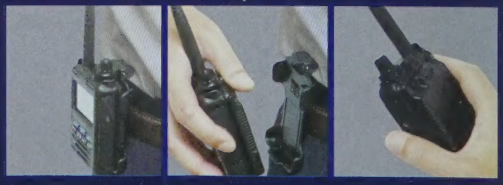




Quick Release Holster and Full Flat-Back Case

Comfortable size & form with no protrusions provides excellent grasp, even when wearing gloves for outdoor activities



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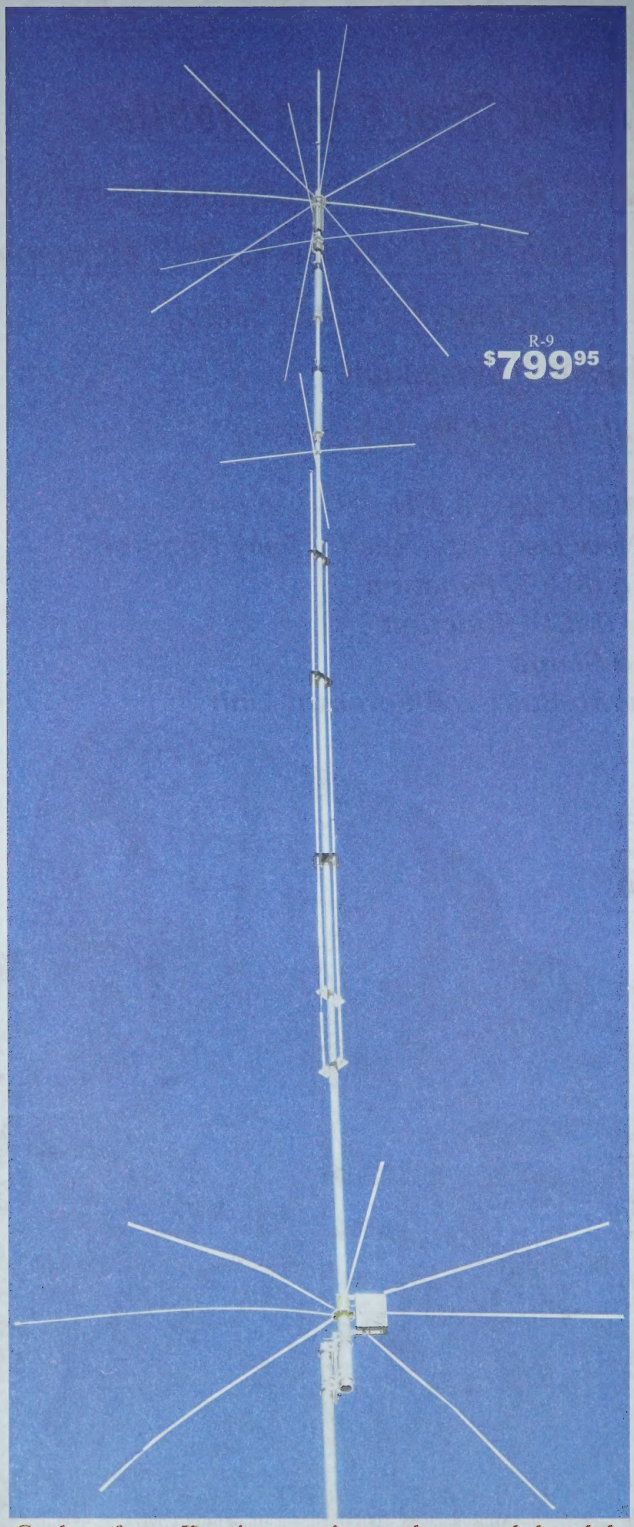

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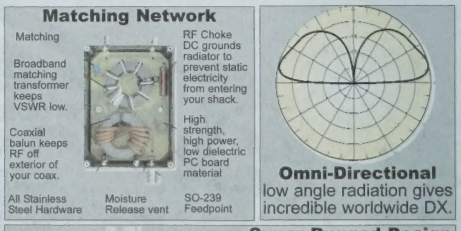
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $699.95. Like R9 antenna but less 75/80 Meters.

R-8TB, $119.95. Tilt-base lets you tilt your antenna up/down easily by yourself to work on.

R-8GK, $99.95. Three-point guy kit for high winds.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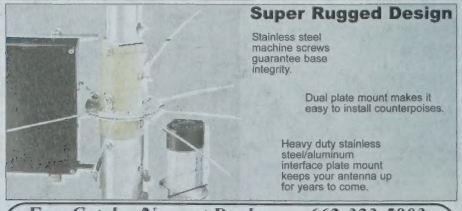
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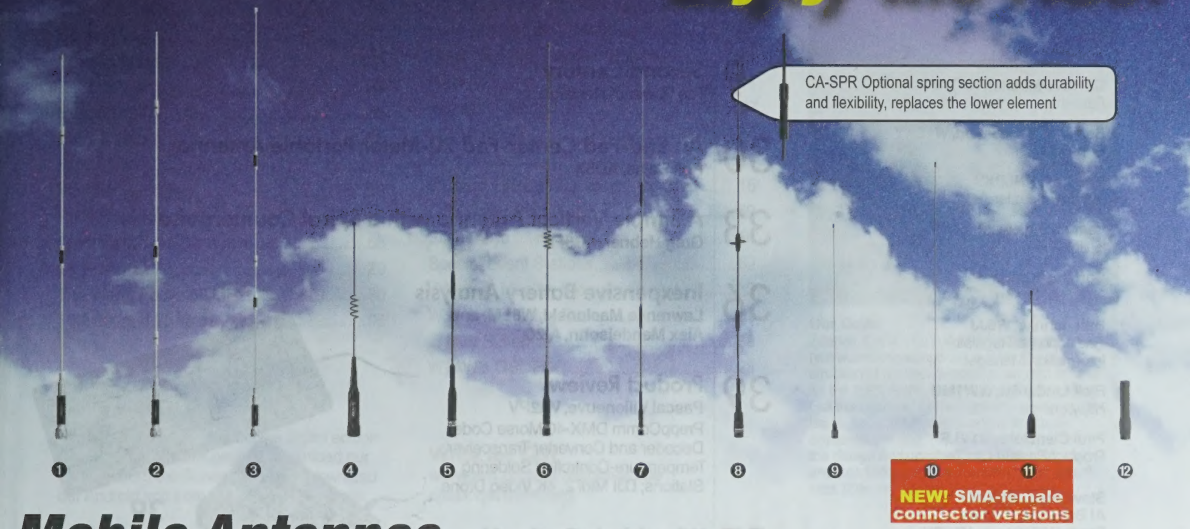

Mobile Antennas

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2M: 1/2 wave • 440MHz: 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 42" • Conn: PL-259 • Max. Pwr: 150W

❷ COMET **CSB-770A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 5/8 wave center load • 440MHz: 5/8 wave x 2 center load • VSWR: 1.5:1 or less • Length: 51" • Conn: PL-259 • Max Pwr: 150W

❸ COMET **CSB-790A** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 7/8 wave center load • 440MHz: 5/8 wave x 3 center load • VSWR: 1.5:1 or less • Length: 62" • Conn: PL-259 • Max Pwr: 150W

❹ COMET **B-10/B-10NMO** DUAL-BAND 2M/440MHz
2M: 1/4 wave • 440MHz: 1/2 wave • Length: 12" • Conn: B-10 PL-259, B-10NMO - NMO style • Max Pwr: 50W

❺ COMET **SBB-2/SBB-2NMO** DUAL-BAND 2M/440MHz
2M: 1/4 wave • 440MHz: 5/8 wave center load • VSWR: 1.5:1 or less • Length: 18" • Conn: SBB-2 PL-259, SBB-2NMO - MNO style • Max Pwr: 60W

❻ COMET **SBB-5/SBB-5NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 1/2 wave • 440MHz: 5/8 wave x 2 • Length: 39" • Conn: SBB-5 PL-259, SBB-5NMO - NMO style • Max Pwr: 120W

❼ COMET **SBB-7/SBB-7NMO** DUAL-BAND 2M/440MHz w/FOLD-OVER
2M: 6/8 wave • 440MHz: 5/8 wave x 3 • Length: 58" • Conn: SBB-7 PL-259, SBB-7NMO - NMO style • Max Pwr: 70W

❽ COMET **CA-2X4SR/CA-2X4SRNMO** WIDE-BAND 140-160MHz 435-465MHz w/FOLD-OVER
2M: 5/8 wave • 440MHz: 5/8 wave x 3 • Length: 40" • Conn: CA-2x4S PL-259, CA-2x4SRNMO NMO style • Max Power: 150W

❾ COMET **BNC-24** DUAL BAND 2M/440MHz HT ANTENNA
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❿ COMET **SMA-24** NEW! **SMA-24J** DUAL BAND 2M/440MHz HT ANTENNA
RX range: 100-1200MHz • Length: 17" • SuperFlex featherweight whip • Conn: SMA-24: SMA-male / SMA-24J: SMA-female

⓫ COMET **SMA-503** NEW! **SMA-503J** DUAL BAND 2M/440MHz HT ANTENNA
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Temperature-Controlled Soldering Stations
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Our Cover
Zdenek, OK1DFC, told ARRL's Contest Soapbox (**www.arrl.org/soapbox**) that he finished construction of his new 8-meter offset dish in time for the 2021 ARRL International EME Contest. Get the overview of the contest's results in this issue, and the full results online at **http://contests.arrl.org**. You can read more about the design and construction of Zdenek's dish at **www.ok1dfc.com/eme/8moffset/8m_offset.htm**. [Zdenek Samek, OK1DFC, photo]

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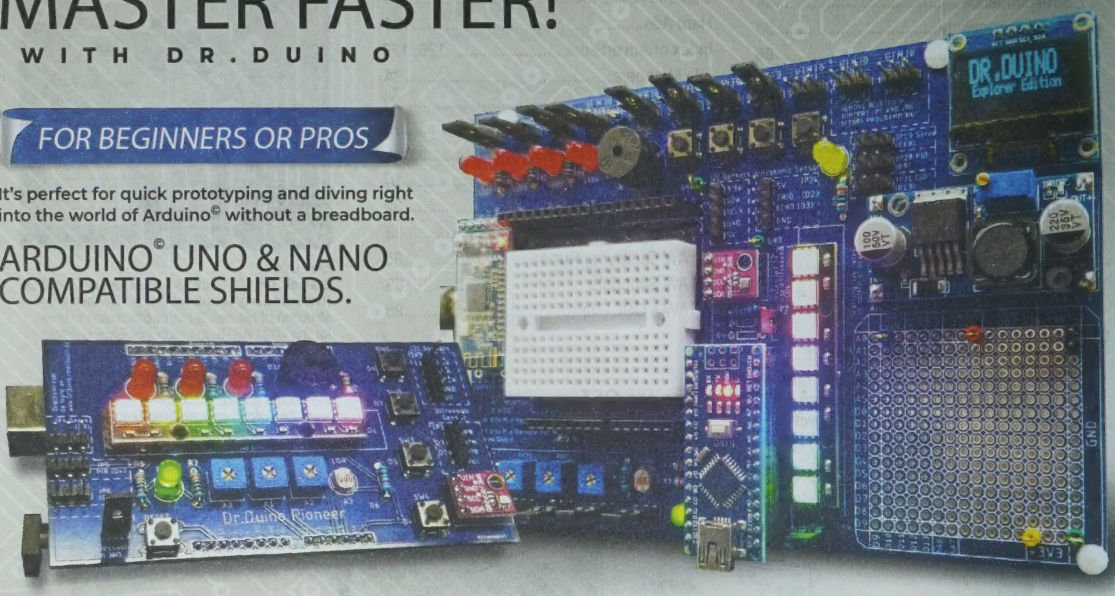

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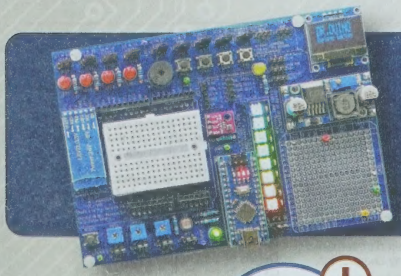

As seen in QST Magazine January 2021

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«The Dr.Duino Explorer Edition is a well-designed development, prototyping and troubleshooting platform»

Revied by Glen Popiel, KW5GP

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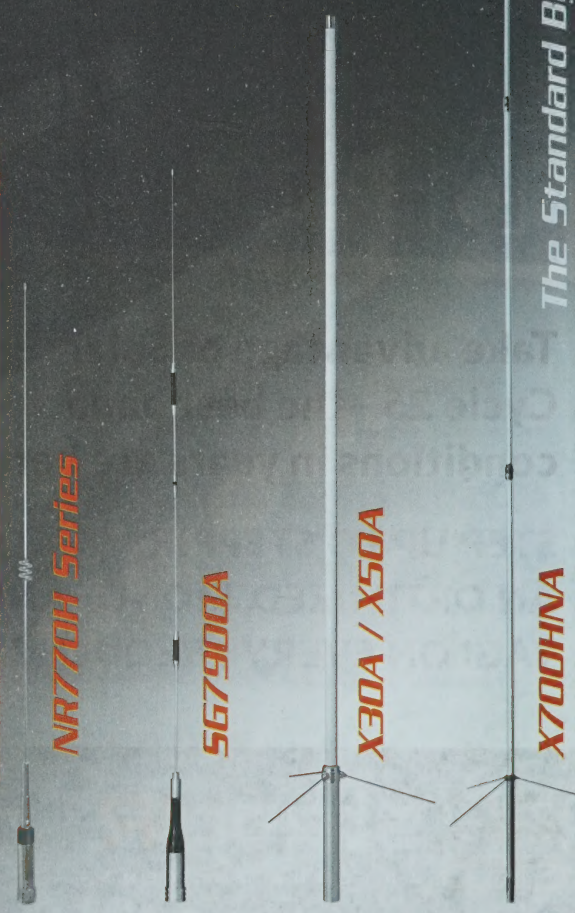
X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas				
F23H (3 Section)	144-174 MHz (W/ Cut Chart)	15	350	UHF
F22A (2 Section)	2m	10.5	200	UHF
CP22E (Aluminum)	2m	8.9	200	UHF
F718A (Coax Element)	70cm	15	250	N
Dualband Mobile Antennas				
SG7900A	2m/70cm	62.2 in.	150	UHF or NMO
SG7500A	2m/70cm	40.6 in.	150	UHF or NMO
NR770H Series	2m/70cm	38.2 in.	200	UHF or NMO
MR77 Series	2m/70cm	20 in.	70	Mag Combo
AZ504FXH	2m/70cm	15.5 in.	50	UHF
AZ504SP	2m/70cm	15.5 in.	50	UHF
NR7900A	2m/70cm	57 in.	300/250	UHF
Monoband Mobile Antennas				
NR22L	2m	96.8 in.	100	UHF
M285	2m	52.4 in.	200	UHF or NMO



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David A. Minster, NA2AA, ARRL Chief Executive Officer, na2aa@arrl.org

Second Century

The Power of Nostalgia

Nostalgic moments can really bring home the value of amateur radio and the relationships we build together over the years. This month, I want to share two random events that I had the pleasure of enjoying recently, and encourage you to reach out to some of those people you met early on in your ham career — even if it was only a few years ago — to see what they have been up to and re-live those moments.

The first occurred at February's ARRL National Convention, hosted by Orlando HamCation. A fellow ham, Mark Levenite, NM7L, walked up and asked if I was originally licensed as WB2MAE. It turns out he remembered working me when I was a Novice back in 1977. I was amazed. I asked if he had the QSL card from back then, and he committed to looking through his collection and sending me a scan if he did. Well, two big surprises! The first was that he did — and there I was, looking at the scans of my QSL card (below) as if I had just written it yesterday. What a thrill. The bigger surprise was my mention of a letter to *QST* (above right)!

As a 15-year-old ham, I was watching people get licensed and then drop out of the hobby due to a lack of local hamfests and no equipment in the Want-Ad Press we used to scan. So, your now-ARRL CEO wrote to *QST* and asked for help! Maybe ARRL could do something whereby a used equipment list could be constructed and mailed so new hams could get their hands on equipment and get on the air! I had completely forgotten this letter! Again, it was amazing to travel back in time to re-experience my life through the eyes of a young, radio-active ham.

NOVICE EQUIPMENT

I am 15 years old and hold my Novice class license. I am writing in reference to why a lot of people may be quitting amateur radio as a hobby. I have seen at least 10 hams drop out because of one big thing . . . POOR EQUIPMENT!! They couldn't afford this new type of gear today, and there were just no hamfests or used places in our area for them to go to. Then one night I was reading how the League did this for hams and the League did that for hams but not too much for Novices and would-be hams in this field. So I thought of a way for the League to help.

The League should start an equipment shop for Novices. Hams could send you a list of gear they want to sell with a price and condition. You could type up a list and sell this list for whatever printing and labor it takes. People would have to be in the League to use this service. If it becomes as popular as I think it will, more people would join the League. You could put little ads in *QST* to announce how to get this list and how to put used equipment on the list.

Please consider this and see what you can do about it. I and probably a lot of other hams and would-be hams are grateful.

David A. Minster, WB2MAE; Wyckoff, NJ

[Editor's Note: The general reaction to the idea from League staff members has been positive. We could use comments from other hams — address comments to Basic Radio Editor, *QST* . *WB9VAT*]

The other event occurred here at HQ. There was a very interesting connection between three hams — me being one of them — back in 1978. I was struggling to send code at higher speeds on a straight key, so my good friend Michael Conwill, N2MW, sold me a Heathkit HD-1410 for 25 cents. It was brand new! But it didn't work. After my dad and I tried to fix it with no luck, we took it to Heathkit for repair. A week later we went back to retrieve it and I met Bob Naumann, W5OV (ex-WA2OVE), who was the tech who fixed the keyer! We became friends from then on.

As three everyday hams, we have wandered in and out of each other's lives over the years. In March, for the first time ever, all three of us were together in one place, at one time, having been connected by a simple Heathkit keyer.

From left to right: Michael Conwill, N2MW; David Minster, NA2AA, and Bob Naumann, W5OV.

What does this all mean? It demonstrates the power of amateur radio to connect us across distance and, indeed, time. Take the time to think back. Drag out those old logbooks. Remember the hams from the late net on 15 meters, who were on after *Saturday Night Live* ended every week? Remember the sked you used to have on 3745 in the afternoons with a local ham because you were rockbound, and he had a Drake TR-4Cw and was magically always right on frequency?

Go back and rediscover the early joy amateur radio brought you by reaching out to some of those early contacts. Be radio active! If those early hams are no longer active, be the connector to get them back on the air. And see you at another hamfest soon.

NA2AA

David A. Minster, NA2AA
Chief Executive Officer

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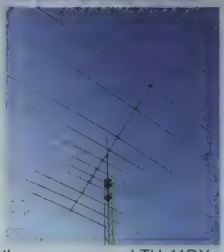
HF Beams



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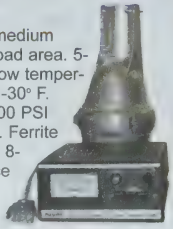

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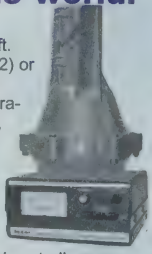
HAM-VII, $1299.95. Like HAM VI but with ***DCU-3*** digital controller with *six programmable memories*.

Tailtwister T-2X . . . $999.95



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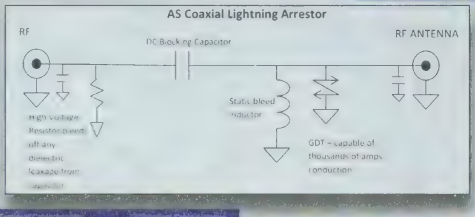

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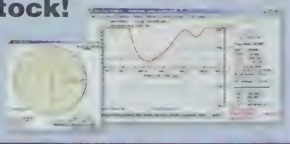

Hamation Station Automation

Hamation remote and Local Station Control products allow you to automatic or manually select antennas, bandpass filters, and control accessories. Accessories can be StackMatches, Antenna switches, antenna phasing systems, SteppIR controller, turning radios on and off, etc. All of this can be done directly from the Ethernet as well!

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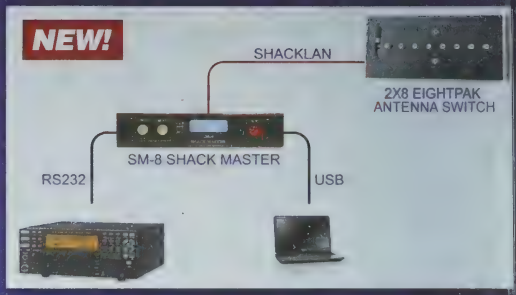
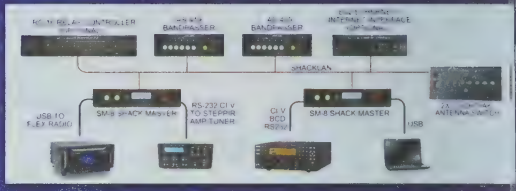


A more complex system could be a SO2R contest station as shown.



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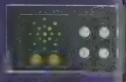

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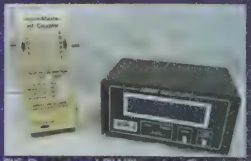
The original, not the imitations. For phasing 2, 3, 4 and even 6 antennas. Also it can be used to combine vertical and horizontal polarized antennas to diminish fading.

PowerMaster II



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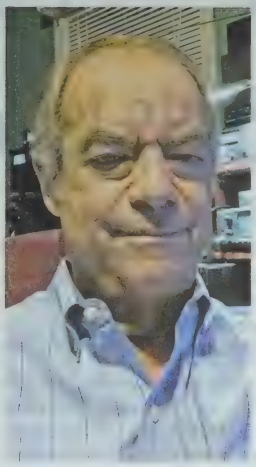
Member Spotlight

David Judkins, KE5RV



David Judkins's, KE5RV, first taste of amateur radio came courtesy of his father, the late Lyn Judkins, K4VBU, in the early 1960s. David spent many evenings listening to him chat with friends on the North Carolina Single Sideband Net from their home in Martinsville, Virginia. Although his father encouraged David to get his license, David admits that he lacked the will to buckle down and study the material, not to mention Morse code.

Despite not having a license, David continued to listen to his father's radios, which included a Collins S-Line and a Drake TR-3. He became an avid shortwave listener and one of his first receivers was a Heathkit that he built as a teenager. According to David, kit building remains an interest to this day.

Amateur Radio at Long Last

Years later, after high school and a couple of years of college, David enlisted in the US Air Force and was surprised to discover that his first job required him to copy Morse code. "While I rarely used it in practice," David explained, "I became pretty good at copying at more than 20 WPM."

He later retrained in another job repairing and calibrating test, measurement, and diagnostic equipment. One of his assignments was at Keesler Air Force Base in Mississippi in the early '80s. Hams at the base had a club station with the call sign K5TYP. The club put an advertisement in the base newspaper about an amateur radio class and invited anyone to take part. That was the incentive David needed. As a result, he was licensed as a Novice with the call sign KA5SMN in late 1983. He upgraded to Technician in early 1984 and then to Advanced, acquiring his current call sign later that same year.

After Keesler, David was assigned to Keflavik, Iceland for a year and held the call KE5RV/TF3. Most of his operating there was on a local repeater because he hadn't taken HF gear along.

After Iceland, David had assignments at Blytheville (later, Eaker) Air Force Base in Arkansas and Seymour Johnson Air Force Base in North Carolina. "While I was still fairly active in those days," David says, "I was more focused on finishing college and earning my Bachelor's and Master's degrees. I finally retired from the Air Force in 1997."

Amateur Radio Today

For many years, David has concentrated primarily on digital modes. He was very active on RTTY and PSK-31 in the 1990s and early 2000s. He also spent time on satellites, especially AMSAT-OSCAR 40 when it was on the air.

Later, David became active with JT-65 and JT-9, earning his ARRL Worked All States awards with both modes. Soon after, he jumped onto the FT8 bandwagon.

He currently enjoys meteor scatter on VHF/UHF and using *VarAC* with the *VARA* modem to chat digitally on HF. "On occasion, I'll try my hand at CW, but I need a lot more practice," David says. "It seemed to be easier when I was a Novice!"

Living in an antenna-restricted neighborhood, David has constructed several different low-profile antennas, although his current HF antenna is an inverted-V dipole on a mast at 25 feet. He also has stacked Yagis for VHF and UHF SSB at 20 feet.

David is a member of a newly formed club, the Crittenden County, Arkansas, Amateur Radio Association. David explains, "We are still getting organized, so we've yet to engage in any activities as a group, but we do have plans for community projects."

More Than Ham Radio

David dabbles in woodworking when he isn't on the air, and he also enjoys reading, primarily history, biographies, theology/Bible study, and spy novels. The shortwave listening habit remains, so he enjoys hunting down signals from utility stations, "numbers" stations, and the occasional pirate broadcaster.

His wife Brenda is a retired elementary school teacher and counselor, and their many activities together include spending time with their Miniature Schnauzer, Grayson.

The Future of Amateur Radio

David believes that getting younger people engaged in ham radio is crucial to the survival of the hobby, yet he acknowledges that there is stiff competition from smartphones and social media. "Even so, I am encouraged when I am able to have an on-air conversation with a young person," David says. "I like to explore their interests. Technology is changing at a fascinating pace, and it is largely the kids that are driving innovation. New technologies and operating modes should be promoted and encouraged by us old-timers."

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A *bona fide* interest in Amateur Radio is the only essential qualification of membership; an amateur radio license is not a prerequisite, although full voting membership is granted only to licensed amateurs in the US.

Membership inquiries and general correspondence should be addressed to the administrative headquarters: ARRL, 225 Main St., Newington, Connecticut 06111-1400 USA.

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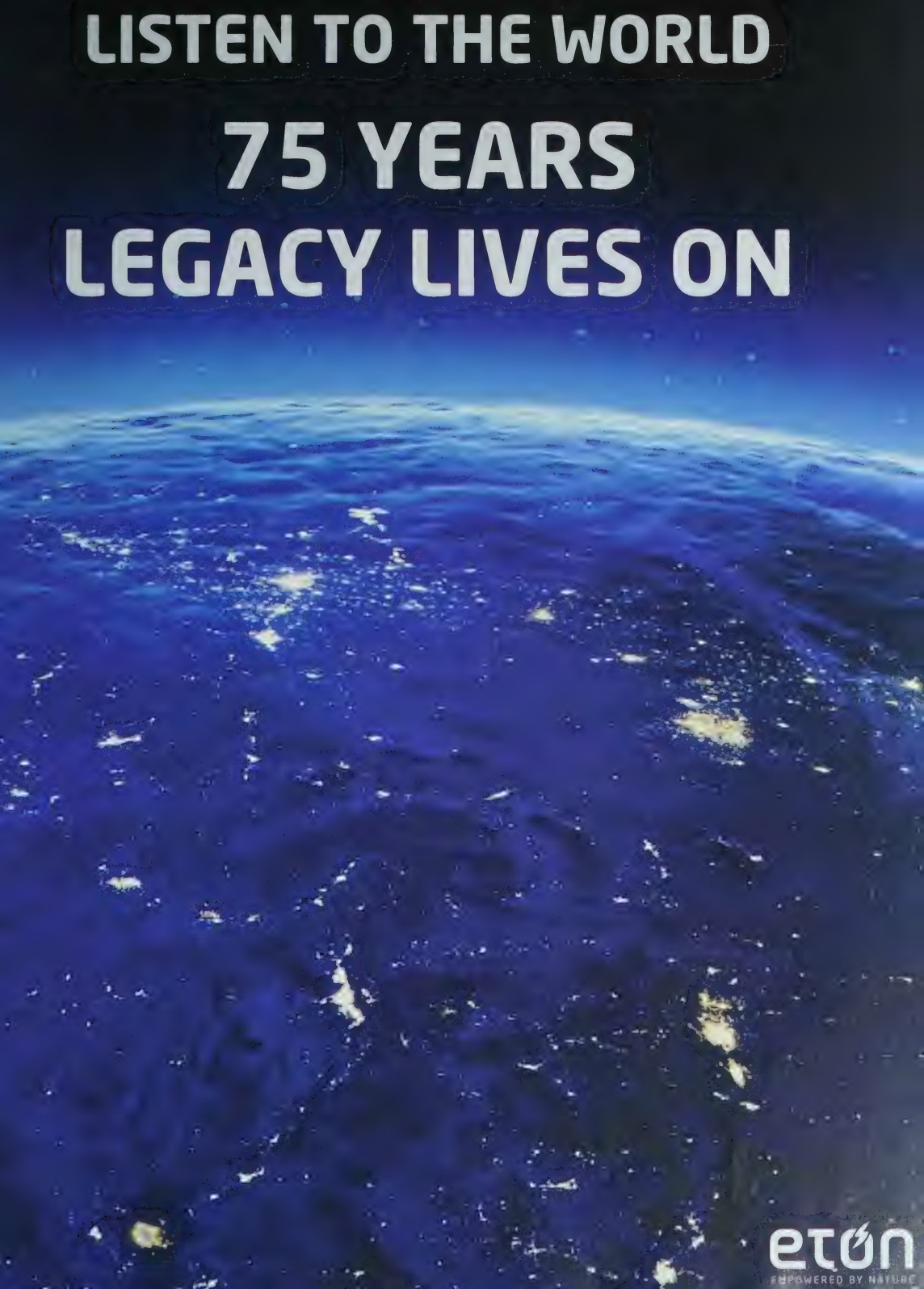
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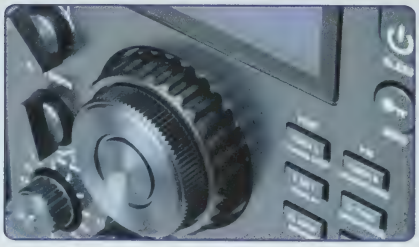

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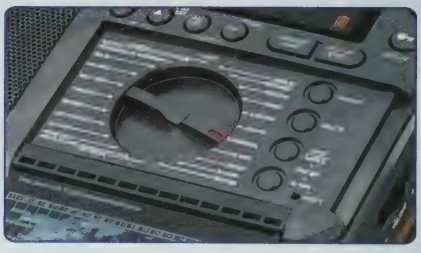

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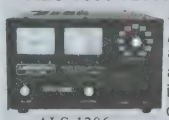
600 Watts PEP/ 500W CW output, 160-6M with automatic instant bandswitching. Desktop. 9¾Wx7Hx14½D". 14.2 lbs. Only 4 dB below 1500W -- less than an S-unit! **ALS-606, $2599,** like ALS-606S above, but has transformer power supply.

Desktop Kilowatt Amplifier

AL-80B
$2399
Suggested Retail

Whisper quiet *desktop* amp plugs into 120 VAC to give *full* kilowatt SSB PEP output. Ameritron's exclusive *DynamicALC*™ doubles average SSB power out and *Instantaneous RF Bias*™ gives cooler operation. All HF bands. 850 Watts CW out, 500 Watts RTTY out, extra heavy duty power supply, 3-500G tube, 70% efficiency, tuned input, Pi/Pi-L output, inrush current protection, dual Cross-Needle meters, QSK compatible, 48 lbs. 14Wx8½Hx15½D". **2-year Ameritron warranty.**

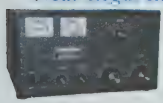
ALS-1306 1200W 1.5-54 MHz Amp



ALS-1306
$3599
Suggested Retail

Ameritron's *highest power* solid state FET amplifier gives you automatic bandswitching! Get 1200W PEP output on all bands, including 6-Meters. No tuning, no warm-up, no tubes to baby and no fuss! Eight rugged MRF-150 power FET's give outstanding reliability. Just 100 Watts drive gives full rated power MHz. Compact 10Wx6½Hx18D in., just 22 lbs. **ALS-1300, $3199.** Like ALS-1306 but less automatic bandswitching and 6-M coverage.

Near Legal Limit [TM] Amplifier



AL-572
$2399
Suggested Retail

Near Legal Limit™ amp gives you 1300W PEP SSB power output for *60%* of the price of a full legal limit amp! Four rugged 572B tubes. Instant 3-second warm-up, 120 VAC. Desktop 14¼Wx8¼Hx15½D". 160-15M. 1000 Watt CW output. Tuned input, instantaneous RF Bias, dynamic ALC, parasitic killer, inrush protection, cross-needle meters, multi-voltage transformer.

HF Amps with 3CX800A7 tube

AL-800
$4199
1 tube, 1250 W
Suggested Retail

AL-800H
$5399
2 tubes, 1.5 kW *Plus*
Eimac(R) *tubes*

Desktop 3CX-800A7 tubes cover 160-15M, WARC bands. Adjustable slug tuned input, grid protection, ALC control, vernier reduction drives, hefty 32 lb. transformer, high capacitance computer grade filter capacitors. Multi-voltage, dual cross-needle meters. 14¼Wx8½Hx16½D".

AMERITRON full legal limit amplifiers

AMERITRON legal limit amps use a super heavy duty power transformers capable of 2.5 kW!

Most powerful -- 3CX1500/8877

AL-1500F
$5999
3CX1500/8877 Tube

AL-1500
$6999
Eimac(R) tube

Ameritron's *most powerful* amplifier uses the herculean 3CX1500/8877 ceramic tube. 65 watts gives full legal output -- loafing with a 2500W power supply.

Toughest -- 3CX1200Z7

AL-1200
$5999
Suggested Retail

Ham radio's *toughest* tube -- the *Eimac*(R) 3CX1200Z7. 50-Watt control grid dissipation. Super heavy duty power supply loafs at legal power -- delivers more than 2500 Watts PEP two tone output for a 1/2 hour.

Classic -- Dual 3-500Gs

AL-82
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Suggested Retail

Gives full legal output using a *pair* of *genuine* 3-500Gs. Competing linears using 3-500Gs *can't* give you 1500 Watts because their lightweight power supplies *can't* use these tubes to their full potential.

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Protects rig from keying line transients. Easy rig hookup.

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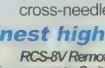
Use 1 coax for **4** antennas. No control cable needed. SWR <1.25, 1.5-60 MHz. Useable to 100 MHz.

RCS-8V Remote Coax Switch...$279.95



Replace **5** coax with 1! 1.2 SWR, 250 MHz. Useable to 450 MHz. <.1 dB loss, 1kW@150MHz.

RCS-10 Remote Coax Switch...$269.95

Replace **8** coax with 1! SWR<1.3 to 60 MHz. **RCS-10L, $309.95** with lightning arrestors.

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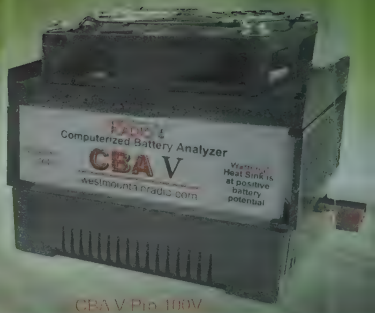

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Free Software

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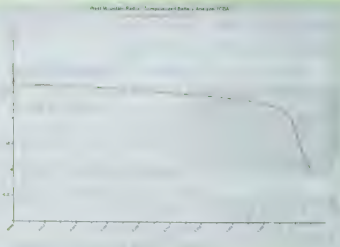
- Multiple Discharge
- Constant Resistance
- Timed Discharge



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The KX3 has become the compact, 160-6 meter, all-mode transceiver of choice for thousands of hams, for home, travel, and portable use. Its versatility has been demonstrated at countless Field Day and DXpedition operations.

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- Precision roofing filter*
- Wide-range internal ATU*

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KPA1500 Features

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Up Front

Removing a Huge Beam from a 58-foot Tower

In Palmyra, Virginia, Bob Pattison, K4DU, (in the yellow hard hat) and his wife, Anne, instructed 11 volunteers as they assisted in removing his 21-year-old Sommer XP706 multiband beam antenna and his 58-foot tower. Bob received his new beam in November 2021, but he had to wait for winter to pass before he could install it. It should be going up soon.

A Musical Tribute to Ham Radio

Allen Chance, W2BUZ, and Paul Rogers co-wrote a song about ham radio called "Back on the Air." The song, which the composers say is a "beautiful tribute to all the ham radio operators in the world," features Morse code that repeatedly says "CQ." You can listen to the song at **www.youtube.com/watch?v=FPHEAaOg674**.

Featured in the video for the song "Back on the Air," the photo shows Allen Chance operating during ARRL Field Day in the early 1960s.

Repurposing a 1983 Microwave Oven as a Cabinet

Amateur Extra-class licensee Bob Sumption, N8RS, built a homebrew power metal–oxide–semiconductor field-effect transistor (MOSFET) kilowatt amplifier and needed a metal cabinet for it. While at a Goodwill resale store, he came across a 1983 Sharp brand microwave oven. He made a new front out of aluminum angle and aluminum sheet. It looks good and works great.

An Analog Clock that Doubles as an Ohm's Law Chart

Karl Schwab, KO8S, said he memorized a few of the basic Ohm's Law formulas many years ago while studying for his amateur radio license, but he has since needed to look them up several times. He wanted to have a handy reference for his project workbench, so he found a color-coded Ohm's Law formula wheel online and swapped it in as an analog clock dial face. His project took less than an hour, and now he has a useful reference as an addition to his radio desk.

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-Tom S. KE8SJQ

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-Joseph P. WA4ONV

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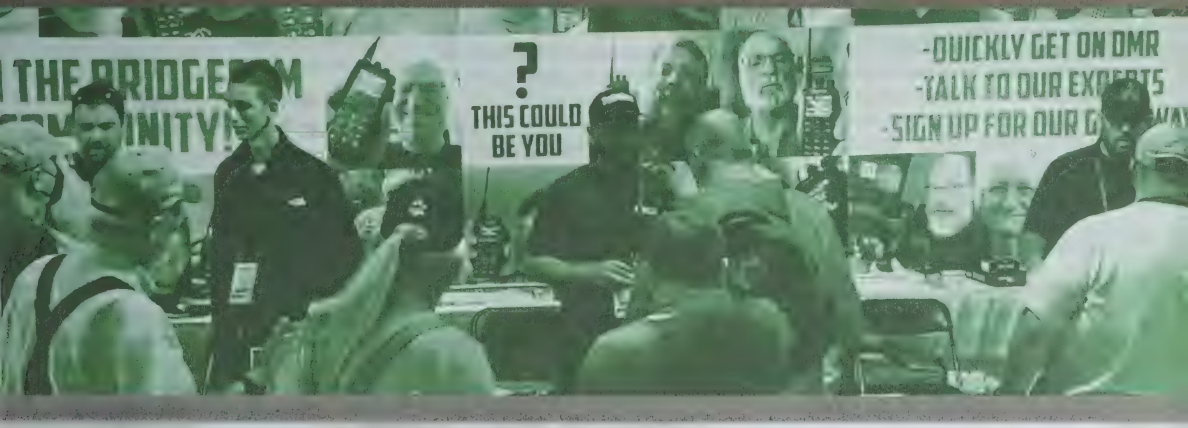

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Correspondence

Letters from Our Members

The Rich Diversity of Our Hobby

As an educator, I have always appreciated the rich diversity of students as they grow into thoughtful and caring people. As an amateur radio operator, I appreciate sharing our common humanity and love for ham radio. Even when we have differing outlooks, we can respect one another and enjoy the hobby that brings us together.

Jim Brinson, K4WOP
Mercersburg, Pennsylvania

A Request to Give Kids Some Airtime

I'm a Boy Scouts of America Scoutmaster and conducted a campout in October, where the boys set up a ham radio station to operate for the annual worldwide event, Jamboree on the Air (JOTA). We had a primitive site away from power lines — a low-noise location that was perfect for contacting other Scout stations. The boys also worked to earn the Radio merit badge. They erected the antennas; set up the tent, batteries, and operating table; connected the equipment, and learned a lot about the technical aspects of a station. This is the second year our troop did a JOTA campout, and overall, they had a lot of fun with it.

JOTA is a great event that attracts youth to amateur radio. However, it can sometimes be difficult to contact other Scouts because many hams not participating in the event operate on the same frequencies. If the kids get discouraged, they may not give ham radio a second chance. Several of my Scouts expressed that they didn't see the point of using ham radio. It was also difficult to keep them focused and enthusiastic during the long periods between contacts with other Scouts.

I suggest that if you're operating during JOTA or the biannual ARRL Kids Day, or if you hear young voices on the air, give the kids some room. Better yet, answer their CQs and talk with them. This will go far to foster their interest in the hobby, and may result in more young hams joining the ranks.

Dale Vestrem, KQ4AD
Hobe Sound, Florida

An Appreciation for Evolving Technology

I've been licensed since 1967, and I look forward to reading "Classic Radio" and "A Look Back" in each issue of *QST*, as they often bring back fond memories.

In "A Look Back" from the September 2021 issue, I found some amusement in something that Dale W. Covington, K4GSX, wrote in his November 1971 article, "Radiated Power Patterns for Multi-band Dipoles." He says: "Unfortunately, lack of available computer time made it impossible to use enough increments to get accurate results on the highest bands." Having worked with computers back then, I am very familiar with their limitations, and often had to "shoehorn" programs to get them to fit in the available memory, and severely limit the amount of processing that could be done in the available computer time.

It's rather amazing to realize that the task described in that article could be readily done today in seconds on a phone (and maybe even on a watch!), in its completeness and with no restrictions.

I can't express how much I look forward to reading *QST* every month. My only complaint is that each issue seems too short!

Andi Tepper, W3NB
Rockville, Maryland
Life Member

More Ways to Decode Aircraft Transmissions

I always enjoy reading articles by Steve Ford, WB8IMY, and the February 2021 "Eclectic Technology" column on aircraft data frequencies was no exception.

I would like to add that in addition to using the *PC-HFDL* program that Steve discusses, you can also decode aircraft transmissions by downloading the high-resolution world map software for amateur radio, *DX Atlas* (**www.dxatlas.com/dxatlas**), that will work in conjunction with *PC-HFDL* and allow for mapping the location of the flights that are being monitored. (I believe that *PC-HFDL* will do the same with Google Maps.) Flight identifications can then be input at **www.flightaware.com** for additional information on the aircraft monitored.

Doug Wilkerson, AAØDW
Loveland, Colorado

Send your letters to "Correspondence," ARRL, 225 Main St., Newington, CT 06111. You can also submit letters by fax at 860-594-0259, or via email to **letters@arrl.org**. We read every letter received, but we can only publish a few each month. We reserve the right to edit your letter for clarity, and to fit the available page space. Letters published in "Correspondence" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made by correspondents.

Check Out What's New at DX Engineering!

ACOM

eBox Ethernet Remote Control Devices for Acom Amplifiers

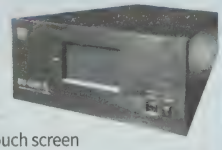
This active Ethernet device directly integrates Acom power amplifiers to the Ethernet networks. Specifically designed for remote control use with the 600S, 700S, 1200S, and 2000A with Remote Control Unit, the eBox receives commands via a web browser-based, user-friendly interface and forwards them to the amplifier. The eBox is compatible with all popular operating systems and web browsers. "P" models include universal wall supply with Euro-U.S. plug adapter.
Enter "eBox" at DXEngineering.com.

Radio Society of Great Britain Radio Today Guides

Andrew Barron, ZL3DW, takes you far beyond what you'll find in the factory instructions for the Icom IC-705, IC-7300, IC-7610, and IC-9700, and Yaesu FTdx101 and FTDX10. These RSGB paperbacks are packed with insights to help you set up the rig, use the array of controls, operate in different modes, troubleshoot, access deeper menu layers, take advantage of firmware upgrades, and more. Also available is HF Data on FT8 & PSK by Rob Walker, G3ZJQ.
Enter "RSGB Today Guide" at DXEngineering.com.

DU4000AL Automatic Antenna Tuner

HA8DU PRODUCTS



The DU4000AL offers unique advanced automation and display features for a 4kW HF antenna tuner. It comes with 1.8 to 30 MHz coverage; an intuitive-to-operate 5-color, 5" touch screen that provides control, status, and metering functionality for all station operations; complete tuning memorization of four rear panel antenna ports plus direct voltage control of an external 8-port antenna switch and stack match switching; and the capability to be interfaced with all types of transceivers. **Enter "DU4000AL" at DXEngineering.com.**

DSP Noise-Cancelling In-Line Module

bhi Noise Cancellation Products

Hear more clearly with this audio DSP unit that cleans up noisy signals and delivers more intelligible audio across all bands. Select from eight noise-cancelling levels via a rotary switch (8 to 40 dB). Other features include tone reduction up to 65 dB, 5W audio amplifier, and audio bypass feature which routes the signal directly through to the loudspeaker when the unit is switched off. The In-Line Module works on most radios and receivers. Patch cable included.
Enter "In-Line 5W" at DXEngineering.com.

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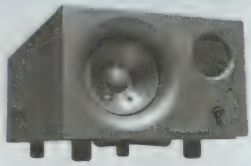
NanoVNA-F V2 Vector Network Analyzer

Used for recording a variety of RF measurements from 50 kHz to 3 GHz (S parameters, VSWR, Smith chart, phase, group delay, and more), this versatile device features a 4.3" IPS LCD display, 5000mAh large-capacity lithium battery for up to a continuous 7 hours of operation, RG405 phase-stable cable, SMA connectors, standard USB port for easy charging, simple firmware upgrades, frequency accuracy of <0.5ppm, and a sturdy aluminum alloy case. Calibration kit, cables, adapters, and stylus included. Also available is an upgraded version with a four times faster sweep speed.
Enter "NCE V2" at DXEngineering.com.

PHONEMA

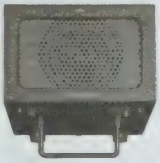


RHEA Speakers

RHEA-2 and RHEA-3 Speakers make a great-looking and even better-sounding addition to any shack. Manufactured with high-end acoustic materials and matched with a high-quality 8 ohm driver, they deliver a rich, balanced sound that is perfect for hours of listening. The speakers (7.3" W x 4.3" H x 10.82" D) are sized to match a range of Icom, Yaesu, Kenwood and Elecraft rigs, but will also work with other transceivers with similar dimensions. The RHEA-3 accepts two audio inputs selected by a front panel switch. **Enter "RHEA" at DXEngineering.com.**

KSP3 Speaker for Elecraft K3 and K3S

PHONEMA



The 30W KSP3 Speaker uses a robust Neodymium driver that's capable of handling higher power levels, providing a clearer and more balanced sound, improved CW signals, enhanced SSB clarity between 1 and 3 kHz, and a wider bass range for more pleasant listening. The speaker (5.98" x 3.70" x 10.28") is sealed and wrapped in a new multi-density box and includes high-grade acoustic foam for superb sound. Its built-in stand matches K3/K3S elevation angles and works with many other similar-size transceivers. **Enter "KSP3" at DXEngineering.com.**

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- 20W DSP noise canceling EQ versions: EQ20-DSP and EQ20B*-DSP * Denotes Bluetooth on input

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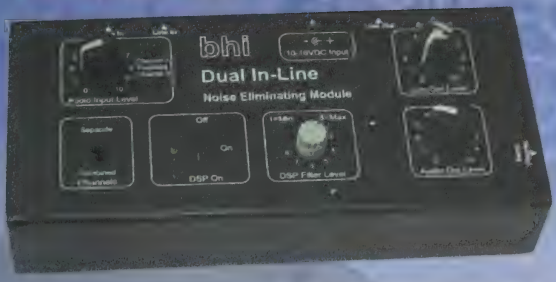
New In-Line Module

Dual In-Line



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NES10-2MK4

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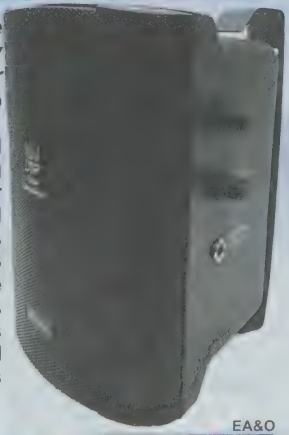

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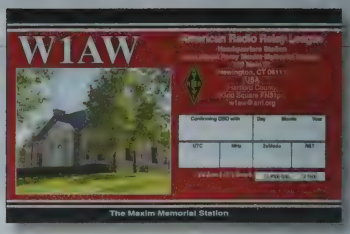
Every month, W1AW receives hundreds of QSL cards from hams all over the world, confirming contact with the Hiram Percy Maxim Memorial Station at ARRL Headquarters. Maybe you'll recognize an on-air friend — or even yourself — among these cards.



The Legend Continues

TS-590S

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An End-Fed Center-Fed 20-Meter Portable Antenna

A simple, matched, end-fed half-wave antenna for portable operation.

Phil Salas, AD5X

My portable operations are almost exclusively QRP CW, and my band of choice is 20 meters, as it's usually open during the day and the antenna size is reasonable. As the new Cycle 25 sunspot activity increases, 20 meters will be open longer, and will provide more reliable low-power DX operation.

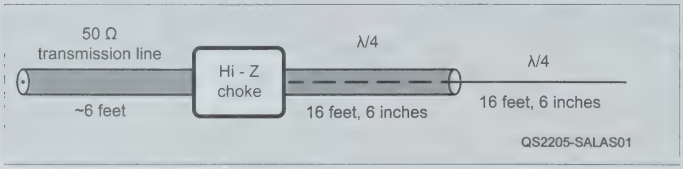
Design Solution

The end-fed center-fed (EFCF) dipole is a good solution for a single-band antenna. The 50 Ω transmission line directly feeds the center of the dipole, and the outside of the transmission line shield provides half of the dipole. This antenna can be erected as an end-fed half-wave dipole, or an end-fed half-wave vertical or sloping vertical. As the EFCF antenna uses the outside of the transmission line shield as half of a dipole, you must provide a high-impedance choke a quarter wavelength back from the center feed point (see Figure 1).

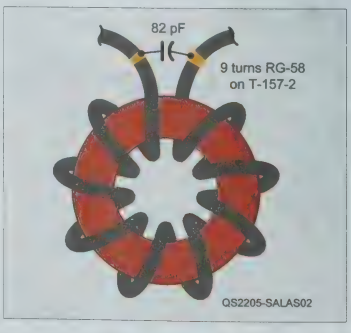
Trap Construction

I chose to use a parallel tuned-circuit trap instead of a ferrite choke as I could get a reasonably high choking impedance with a small form factor. The drawing of the trap is shown in Figure 2. It consists of nine turns of RG58 wound as a single layer on a T157-2 powdered iron core, and an 82 pf resonating capacitor. I calculated that 110 pf would be needed, but the interwinding capacitance was high enough such that only 82 pf was required.

I began by purchasing a 25-foot section of RG58 cable with BNC connectors on each end. It is important that the cable has a copper — not aluminum — braid. Cut off the connector on one end and wrap nine turns of the coax through the toroid, leaving 16½ feet of coax between the toroid and the cut end of the coax. This leaves about 6 feet of feed line for



▲**Figure 1** — The final dimensions for the end-fed center-fed dipole antenna.



▶**Figure 2** — The trap schematic. There is one pass through the toroid center per turn. The nine coax turns will fit snugly as a single layer.

▲ **Figure 3** — The tinned and tie-wrapped cable.

▶ **Figure 4** — The finished trap.

Table 1
Trap Component Temperatures versus RF Power Level

TX Power (W)	Toroid Temp (°F)	Coax Winding Temp (°F)	Capacitor Temp (°F)
15	83	83	83
25	87	87	87
50	91	99	91
100	94	121	103

your transceiver-to-antenna interface. The feed line can be extended, if needed. Use a tie wrap to hold the ends of the coax together as they exit the toroid. Then, carefully scrape some insulation from each end of the RG58 right as it enters and exits the toroid. Tin the braid at these two points, as shown in Figure 3. Finally, solder an 82 pf, 1 kV mica capacitor across the shields of the two cable ends, as shown in Figure 4.

I originally left the uncut capacitor leads in place, so I could measure the trap isolation with my VNA. Figure 5 shows the measured trap isolation. Note that it is better than 31 dB across the lower half of the 20-meter band, which is equivalent to a trapping impedance of over 3,500 Ω.

Keep in mind that the trap is only effective on the outside shield. The transmission line — which consists of the inside of the shield and the center conductor — is unaffected.

Dimensions and Supports

The final dimensions of the antenna are shown in Figure 1. Notice that the dimensions follow the 468/f equation for the dipole length, as this really is just a

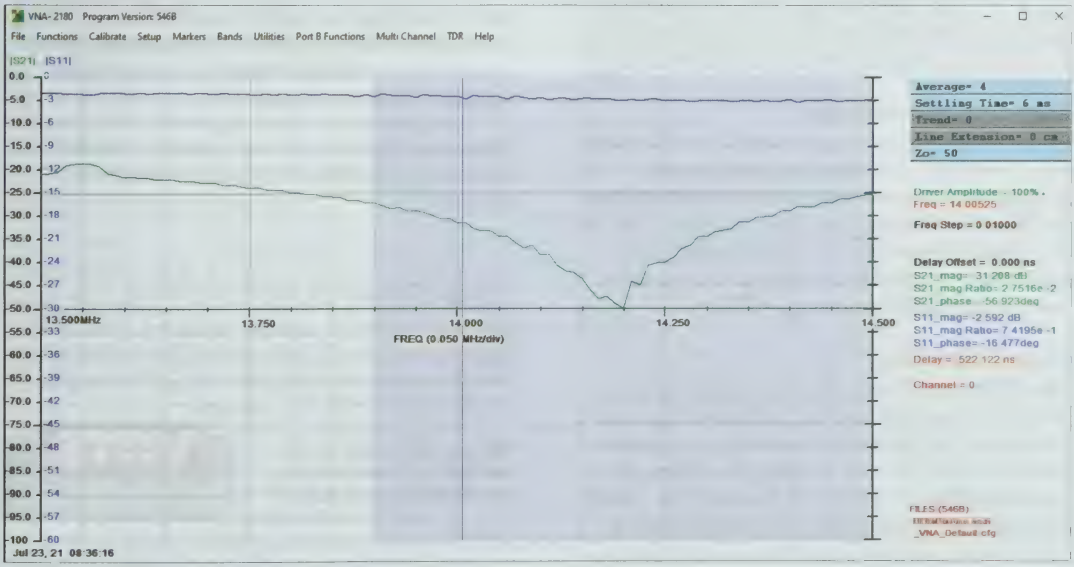


Figure 5 — The trap isolation measurement.

▲**Figure 6** — The wire and coax junction.

▶**Figure 7** — The end insulator and support.

Figure 8 — The measured SWR of the EFCF antenna.

dipole. The ¼ coax section is measured from the point the capacitor is soldered across the shields. A nylon spacer filled with hot glue strengthens the connection of the coax center conductor and wire end, as seen in Figure 6. Another nylon spacer at the wire end is attached to a nylon cord and then to a large nut, so the antenna end can be easily attached to a railing or thrown up into a tree (see Figure 7).

Standing Wave Ratio

Figure 8 shows the RigExpert AA55 Zoom Analyzer measured SWR of the antenna arranged as a sloping half-wave antenna with the far end attached to my second-floor balcony railing. The feed end was on a picnic table where I had my 20-meter QRP radio. The lead photo shows the rolled-up antenna ready to go on my next outing.

Power Handling

The RF voltage at the open end of a dipole can be quite high, depending on the power level. Circulating currents in the inductor and capacitor (*L*/*C*) parallel resonant circuit can also be high. Depending on various assumptions (antenna *Q*, characteristic impedance, wire dimensions, etc.), you can calculate a variety of answers with regard to power handling. I decided that the easiest way to determine the trap's power handling capability was to simply measure the trap component's heating at various power levels. I set up my Icom IC-706MKIIG feeding this end-fed dipole. The ambient outside temperature was 83 °F during the tests. All measurements were made after a 30-second continuous key-down period using a Kintrex IRT0421 infrared thermometer. The results are shown in Table 1.

Based on these measurements, I'd be comfortable using this antenna at power levels up to 100 W with low duty cycle modes (CW and SSB). However, for high duty cycle modes, you may want to keep the power level at 50 W or less. If you want to operate at 100 W and high duty cycle, I'd recommend replacing the capacitor with two parallel-connected 42 pf/1 kV micas. Use a T184-2 or T200-2 toroid and Teflon-insulated RG58 for the coax.

This is an effective and easy-to-deploy 20-meter antenna for portable operation. Build one and have fun!

Phil Salas, AD5X, an ARRL Life Member, has been licensed continuously since 1964. His interest in ham radio led him to pursue BSEE and MSEE degrees from Virginia Tech and Southern Methodist University, respectively, followed by a 35-year career in RF, microwave, and lightwave design and management. Now fully retired, Phil enjoys tinkering with ham radio projects and spending time with his two grandsons.

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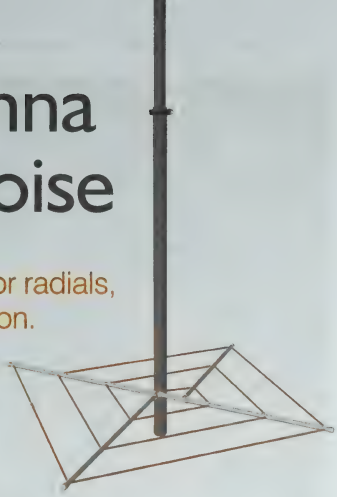
A Simple Vertical Antenna with a Spiral Counterpoise

If you don't have space for radials, this project offers a solution.



Greg Hebner, AG5FE

When I temporarily moved to the east coast from the southwestern desert, I had a yard with tall trees. I was finally able to put up 40-meter antennas and enjoy making DX contacts. This inspired me to design something that could work just as well from my permanent, treeless desert home.

I had some major constraints. The antenna had to be self-supporting and safe for backyard guests, but there was little space for radials. An internet search for a "coiled counterpoise" gave me some encouragement and prompted me to consider performance and antenna patterns compared to the classic quarter-wavelength vertical with many radials. To explore options, I used the free *4nec2* modeling software at **https://www.qsl.net/4nec2** and the costly *NEC-4.2* engine from Lawrence Livermore National Laboratories, informed by *The ARRL Handbook*.

Learning from a Model

My first model of a quarter-wavelength vertical (33 feet at 7.05 MHz) and a single, coiled counterpoise of similar length had poor gain and voltage standing wave ratios (VSWR). I struggled with questions and variables, such as the length of the wires, overall counterpoise dimensions, and how to use *4nec2* to optimize strange counterpoise shapes.

I realized that I could first choose a counterpoise shape that would fix the x and y coordinates of every wire. The *4nec2* program multiplies each coordinate by a single scaling number to arbitrarily stretch the relative shape and the total length of the spiral counterpoise. Adding a vertical wire to the spiral completed the design. The *4nec2* optimizer adjusts two terms, the length of the vertical and the spiral scale factor. This works to optimize the SWR and gain. To my surprise, the model converged on a design with a minimum VSWR of 1.1:1, an azimuthally constant gain of –0.7 dBi, and a 2:1 VSWR bandwidth of 280 kHz. The vertical length was 39 feet for a center frequency of 7.1 MHz, which is 15% longer than a quarter wavelength. The spiral counterpoise length was 33 feet, 7 inches, which is almost a quarter wavelength. No wonder my first attempt was so poor.

The antenna design study provided good insight on how to construct the physical antenna. The real impedance was dependent on the length of the vertical but weakly dependent on the number of spiral turns. The imaginary impedance depended almost equally on the vertical length and the number of spiral turns. Thus, the length of the spiral is tuned first to adjust the imaginary impedance. Then the length of the vertical is adjusted to tune the real impedance. I first trimmed the length of the spiral wire length to minimize the VSWR, irrespective of the minimum frequency. The vertical length was then trimmed to move the VSWR minimum to the desired operating frequency.

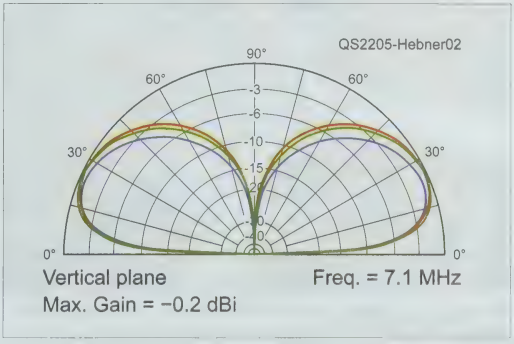


Figure 1 — The blue curve is my antenna, while the green and red represent a conventional quarter-wave vertical with above or in-ground radials.

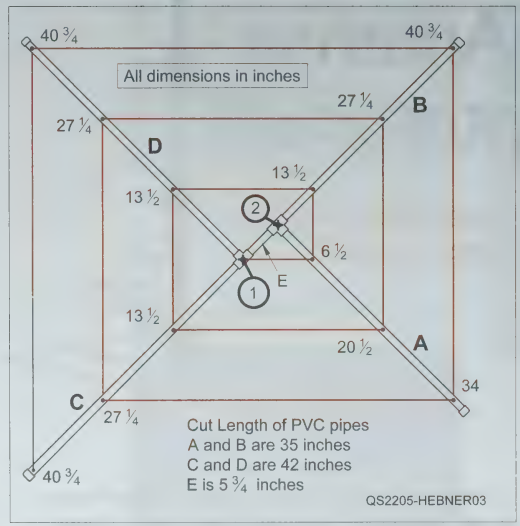


Figure 2 — The spiral frame assembled using five pieces of ¾-inch PVC. The points on arm A are measured from point 2.

Figure 3 — The spiral wire was secured with cable ties at each corner, and the inside end was connected to the balun. The vertical wire connects to the other output terminal of the balun.

Encouragingly, the modeled antenna gain patterns for realistic ground conditions (see Figure 1) were within 1 dB of the performance of a traditional quarter-wavelength vertical with 16 ground radials and a common quarter-wavelength vertical with four elevated radials, especially compared with the takeoff angles that would be needed for good DX performance. The azimuthal gain was constant, unlike the asymmetric gain obtained by bending radials to fit confined spaces. The VSWR bandwidth was smaller than the 500 kHz of a traditional radial field, but acceptable across the entire 40-meter band.

Construction

A simple frame to hold the spiral counterpoise was constructed from ¾-inch PVC tubing with 3⁄16-inch holes drilled at the locations shown in Figure 2. Starting from the center of the PVC frame, I pulled insulated #14 AWG solid copper wire to each point and held them with a cable tie looped up through the holes (see Figure 3). The final wire can be left long to tune the spiral. Avoid bending the PVC frame by pulling too hard on the wire. A 1:1 current balun was used to reduce feed line coupling.

Hanging From a Tree Branch

For the prototype, I tested it in a tree in my yard on an overhanging branch 65 feet off the ground. An insulator was attached to one end of the vertical element. The other end was attached to the center of the spiral frame, and then the balun was connected. The insulator was tied to a rope and pulled up over the tree branch. For safety, the spiral should be elevated, because the end of the counterpoise will have high RF voltage. In my first prototypes, I left a 1-foot-long section to tune the spiral length, but I later calibrated the model for the dielectric constant of the insulated wire to avoid a hanging wire. The lengths in Figure 2 include this calibration factor and can be built as is. I tuned the vertical length (approximately 39 feet) for minimum VSWR at the operating frequency. The minimum VSWR was less than 1.3:1, with a 2:1 VSWR bandwidth of 310 kHz, which was slightly greater than modeled.

Free-Standing Antenna

The free-standing prototype (see Figure 4) used a 41-foot, segmented fiberglass pole. The base used a 2 × 4 timber cemented into a 5-gallon plastic bucket. The base for the pole was a wooden block attached 19 inches below the top of the 2 × 4. The pole was attached with hose clamps, and the PVC assembly slid over the fiberglass antenna and was loosely secured to the 2 × 4 with two ¾-inch plastic tube

Figure 4 — A view of the free-standing antenna.

Figure 5 — The balun and supports.

hangers. The pole was then extended segment by segment and secured by the manufacturer's clamps. Per the manufacturer's guidance, guy lines were attached to the pole.

The vertical was #18 AWG magnet wire held in place by fishing line that could sustain 100 pounds. A wire ring at the top of the pole reduced string drag when adjusting the vertical wire. To keep the pole from bending when hoisting the vertical wire, it was threaded through cable-tie loops attached to the top five pole segments. A friend helped me pull the antenna to vertical and secure the guy lines. The spiral was secured into position with a short piece of PVC, the balun was connected and feed coax installed. The spiral was 10 feet above the ground to reduce hazards involving the high RF voltage. Antenna characteristics were measured from a distance of 15 to 30 feet.

On-air comparisons of signal strength between this antenna and my full-wave loop antenna were usually within 1 dB and consistent with *4nec2* gain calculations. This antenna has become my day-to-day 40-meter antenna and should be a solid performer as we enter the next solar cycle.

Inspiration for Further Experiments

This compact design met my goals for the antenna pattern and exceeded my expectations regarding peak gain and DX signals. The design of the spiral counterpoise is only limited by imagination and demonstrates the importance of models to guide experimental construction. Other counterpoise geometries, such as stars and extended spirals, showed promising performance but were not investigated in detail. Despite the strong inter-wire coupling implied by models, my versions have been stable through many rain- and snowstorms.

I am sure there are extensions of this concept, and I look forward to seeing what others invent.

All photos by the author.

Amateur Extra-class licensee Greg Hebner, AG5FE, has over 35 years of laboratory experience in RF, microwave, and optical measurements. He has a BS, MS, and Ph.D. in electrical engineering from the University of Illinois. As a ham, his interests include building electronic widgets, experimenting, and learning CW. He can be reached at **ag5fe@arrl.net**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Inexpensive Battery Analysis

Find out how well your batteries are really working.

Lawrence Macionski, W8LM, and Alex Mendelsohn, AI2Q

It is rare to find an amateur radio operator that doesn't use batteries — especially rechargeable batteries — to power equipment. If you're looking to use an inexpensive battery, following this procedure will give you an efficient way to test and analyze how well your equipment and batteries are working.

Units of Measuring Charge

The unit for charge is the *coulomb* (*C*), which is about 6.2×10^{18} electrons. One coulomb passing a given point in 1 second is called 1 *ampere* (*amp*, *A*). Amps multiplied by hours is another unit for charge, 1 A for 1 hour (3,600 seconds), being 3,600 coulombs.

Batteries are rated by their charge storage in *amp-hours*, or *Ah*. Amp-hours are the current in amps multiplied by the number of hours it can be drawn. Smaller batteries are usually designated in milliamp-hours (mAh). As you drain a battery, even if the load is fixed, the current is changing. So, if you fully charge a battery, and then hang a fixed resistive load on that battery and measure the time it takes to reach the depleted voltage, you will know the time, but you won't know the current accurately, because as the voltage dropped, the current changed. Even the resistor might change value slightly as it heats up.

Using a Charge Counter Module

The heart of this project is a module called ZB2L3 or HW-586 (see the sidebar, "ZB2L3/HW-586 Module Specifications"). It is a charge counter and calculator that you can buy online. Before starting the project or using the module for testing purposes, follow a verification procedure to confirm the module purchased works properly.

The ZB2L3 or HW-586 module (see Figure 1) can automate the process by energizing a load to the battery, starting a clock and sampling current and voltage during the test period. When the depleted voltage point is reached, the module calculates the time against all the sample currents it measured. It then displays final amp-hours and flashes rapidly to indicate completion.

The module is powered with a cell phone ac adapter, or a microUSB 5 V power adapter. To use, connect a fully charged battery (between 1 and 15 V) and adjust a depleted (termination) voltage set-point with the **UP** and **DOWN** (+ and –) buttons on the ZB2L3. Then push the third button to start the test. A solid-state relay then switches in the load, which can't exceed 3 A, and the display alternates from volts to amps to accumulated amp-hours until the test is finished. The ZB2L3 can read up to 9,999 Ah, which is much more than any normal battery could store.

Figure 1 — The module as received. We marked the negative (–) battery terminal with an indelible pen prior to mounting the circuit card module for identification. The polarity of the battery is very important. The terminals are labeled on the bottom of the board. Once it is mounted, the labels can't be seen.

ZB2L3/HW-586 Module Specifications

Power supply: 5 V at 70 mA (micro-USB connector)
Tests batteries from 1 – 15 V
Termination voltage range: 0.5 – 11.0 V
Maximum supported battery drain current: 3 A
Maximum voltage measurement error: 1% + 0.02 V
Maximum current measurement error: 1.5% ± 0.008 A
Maximum battery capacity range: 9,999 Ah
Board size: 2 × 1.5 inches (50 × 37 millimeters)
Board net weight: 1 ounce (28 grams)

Figure 2 — The mechanical mounting of the load resistor and module. The standoffs provided used metric screws and were threaded. We used sheet metal self-tapping screws, because the heatsink was soft aluminum.

Improving the Module

Before beginning the project, collect the necessary materials, as shown in the sidebar, "Recommended Parts List."

To build your tester, you should mount the components on an aluminum heatsink (see Figure 2). We opted for an 8 Ω, 100 W resistor. It draws 1.5 A at 12 V, and it gets very hot. Don't use the 7.5 Ω, 5 W resistors that may be included with the product. They are very under rated. [Testing a large 12 V battery will dissipate 18 – 20 W over an extended period of time, so a larger heatsink and/or a small fan would be a good idea. Putting the assembly in an enclosure with restricted air circulation is a bad idea. — *Ed.*]

As the resistor gets hot, it will change value; however, the ZB2L3 will compensate for the thermal change. Use heavy-gauge wire for the interconnections to keep voltage drops to a minimum. Depending on the capacity of the battery, testing can take several hours, or in the case of a good 105 Ah deep-cycle fishing battery, it can take days. After all, you are depleting the battery at 1.5 A. (105 Ah / 1.5 A = 70 hours).

To use, first fully charge your battery properly, whether it is a 12 V car battery, gel-cell, AGM, or deep-cycle type. We used a DieHard microprocessor-controlled charger. Smaller cells, such as the 3.7 V LiPo and 1.2 V NiMH types, should be charged using the manufacturer's recommended charger.

Keep a log of the batteries you check. You may find it valuable if something doesn't seem quite right, or you're wondering if your battery is no longer up to full capacity.

Recommended Parts List

ZB2L3 or HW-586 module

8 Ω, 100 W heatsink mountable resistor

4 × 3 × 1-inch heatsink, or similar

#16 AWG wire

Heat-shrink tubing to fit resistor leads

Micro-USB cell phone charger 5 V, 1 A

Alligator clips, 1 red and 1 black

Powerwerx red/black bonded zip cord, #16 AWG wire, 12 – 18 inches

Self-tapping sheet metal screws for mounting the resistor and module

Test Results

This procedure and low-cost equipment can analyze and test batteries with repeatable results. We have tested many batteries with this setup. Medical-grade 12 V batteries — even used ones — were very good when using 10.5 V as the depletion set point. Some economy 12 V batteries underperformed. Chinese 18650, 3.7 V cells from eBay were much less than their claimed mAh capacity.

Detailed results of the tests and useful battery information can be found on the *QST* in Depth web page at **www.arrl.org/qst-in-depth**. There is also a diagram of the project tester and suggestions about how to keep records of your tests.

ARRL Life Member Lawrence "Larry" Macionski, W8LM, has been licensed for 55 years. He is a retired Senior Field Engineer from Maintech Inc. Larry lives on a 25-acre cattle ranch in Mulvane, Kansas, and enjoys traveling across the US with his HF radio in his car. In the 1980s, he wrote a CW send-and-receive program for the Commodore VIC-20 home computer. He now focuses on DIY, Arduino, and Raspberry Pi projects. He mentors new hams, and for 12 years, he has been an ARRL Volunteer Examiner Team Leader at Veterans of Foreign Wars Post 3115 Amateur Radio Club and maintains their repeaters. He is Trustee of the N8NCC Memorial Club, and a charter member of the 3905 Century Club. He monitors 146.52 MHz. He can be reached at **w8lm@arrl.net**.

Alex Mendelsohn, AI2Q, has been licensed since 1959. He is an ARRL, RSGB, and FOC member. He founded the New England Radio Discussion Society. Alex holds an FCC General Radio Operators License and is certified by the International Society of Certified Electronics Technicians (ISCET). Now retired, Alex taught electronics at Grumman Data Systems Institute, Briarcliffe College, and the Portsmouth Naval Shipyard. He is a former chief editor for several publications, including *Integrated Circuits* magazine, *EE Product News*, and *Portable Design* magazine. He has a BA in geography from Hofstra University. Alex can be reached at **ai2q@arrl.net**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Steve Ford, WB8IMY, wb8imy@arrl.net

Eclectic Technology

JS8Call

FT8 is by far the most popular HF digital operating mode in amateur radio today. For many amateurs, however, its main shortcoming is that you can't use it to enjoy a true conversation. A contact made with FT8 is just that — a "contact" only.

Figure 1 — Detail of the *JS8Call* interface, showing W9COA sending a JS8 CQ.

Several years ago, Jordan Sherer, KN4CRD, wondered if it might be possible to combine the robust ability of FT8 to communicate at weak signal levels with a true conversational component. The result was a modified form of FT8 that Jordan called JS8. He then constructed a directed-calling messaging protocol using JS8 and brought it to life in a software application known as *JS8Call*.

JS8Call is free and available for computers running Windows, Linux, or MacOS. You can download the files at **files.js8call.com/latest.html**.

Setup Notes

If you've already installed *WSJT-X* at your station, setting up *JS8Call* will be familiar. You'll need to enter your call sign and grid square designator. If you are using an external interface to connect your computer to your transceiver, you will need to specify the COM ports for keying and CAT control (if used), as well as the audio input and output devices.

On the Air with *JS8Call*

If you've operated FT8, you know that each 12.6-second transmission sends only 13 characters (including spaces). The same is true for *JS8Call*, but the software chops longer message texts into 13-character segments and sends each segment individually. So, at the receiving end, the full text is reassembled, one segment at a time. There are JS8 "watering holes" on most HF bands (see Table 1).

JS8Call Speeds

At the time this was written, *JS8Call* could operate in four different speed modes. Slower modes permit decoding at weaker signal levels (see Table 2).

The idea is to start your contacts in the Normal mode and then shift to Fast, or even Turbo, if conditions permit. Or, if conditions become difficult, downshift to the Slow mode.

Calling CQ is as easy as clicking your mouse cursor on the **CQ** button. If you see someone calling CQ, just double click on their text and type your reply (see Figure 1).

Heartbeat Transmissions

One cool feature of *JS8Call* is the *heartbeat* transmission. Simply put, it is a way to determine who you can communicate with at any given time.

Turn on the heartbeat (**HB**) button by selecting **ENABLE HEARTBEAT NETWORKING** from the **MODE** menu. An **HB** (or **HB+ACK**) button will then appear on the left-hand side of the strip of buttons in the middle of the *JS8Call* screen. If you click your mouse cursor on this button, *JS8Call* will transmit your grid square at the next available opportunity.

Wait a bit, and you're likely to see automatically generated replies and signal reports from stations that decoded your signal. If you have "auto" replies enabled and you've selected **SEND HEARTBEAT ACKNOWLEDGEMENTS**, your station will send replies to other heartbeat inquiries as well.

Table 1
JS8 Frequencies

Band (meters)	Frequency (MHz, USB)
160	1.842
80	3.578
40	7.078
30	10.130
20	14.078
17	18.104
15	21.078
12	24.922
10	28.078

Table 2

Mode	Frame Lengths (seconds)	Bandwidth (Hz)	Speed (WPM)	Minimum Decodable Signal Level
Slow	30	25	8	–28 dB
Normal	15	50	16	–24 dB
Fast	10	80	24	–20dB
Turbo	6	160	40	–18dB

Product Review

PreppComm DMX-40 Morse Code Decoder and Converter Transceiver

Reviewed by Steve Ford, WB8IMY
wb8imy@arrl.net

The PreppComm DMX-40 may be the most unusual transceiver I've ever reviewed — a low-power (QRP) 40-meter CW radio that receives from about 5 to 10 MHz and transmits on 7.0 to 7.3 MHz. But similarities to conventional transceivers end there.

With the DMX-40, PreppComm has created a radio intended primarily for inexperienced operators. The first paragraph in the "Overview" section of the DMX-40 reference manual summarizes the philosophy:

> The DMX-40 was created to make it possible and easy for non-technical people to utilize the HF amateur radio bands for battery-powered emergency communications. This is done by providing a texting interface to the user, making communications via Morse code like texting on a modern smartphone: simple, easy, and fun. It also provides a fantastic platform for learning Morse code, *should the operator have an interest in doing so*. [emphasis mine]

So not only does the operator not need a knowledge of Morse code, he or she doesn't even need a desire to learn the code.

This may seem sacrilegious to some amateurs, but I understand PreppComm's aims. They've manufactured a radio that not only exploits the tenacity of Morse code CW communications under difficult conditions even at low power levels, but also eliminates the need for Morse fluency on the part of the operator. The touchscreen sign-on message declares the device a "Morse Code Radio Texting System," which means the communication is really through text, and Morse code is just the intervening means to that end.

This will no doubt provoke the question, "Why not just use a weak-signal digital mode such as FT8, or its conversational cousin JS8Call?" Well, these modes require external computers to run the software. That's an additional physical burden during portable operations, not to mention an additional drain on limited power sources.

In contrast, the DMX-40 does everything within a single, compact package. Not only does it send CW, but it also decodes CW to its 3.5-inch color LCD touchscreen. Along with the miniature USB keyboard supplied with the transceiver, you need only a 12 V battery, a 40-meter antenna, and an appropriate length of feedline. The unit's antenna output is a female SMA jack on its side. You don't even need a key, because all operator input is from the keyboard.

Before using the DMX-40 for the first time, you must set it up by entering your call sign and license class, among other things. If you tune the transceiver to a

Bottom Line

With the DMX-40, PreppComm has created a radio intended primarily for inexperienced operators, to make it possible and easy for non-technical people to utilize the HF amateur radio bands for battery-powered emergency communications.

frequency your license class does not permit, it will automatically disable transmission. You can still receive, but you can't send.

Many functions — including frequency tuning — are controlled from the USB keyboard. This aspect makes the learning curve somewhat steep, so it is a good idea to print a copy of the keyboard layout guide and keep it handy. The touchscreen provides access to various operating functions, as well as the radio's menu system.

Receiving and Decoding

The DMX-40 has a direct-conversion receiver, and its design architecture doesn't offer a selection of narrower front-end filtering. You soon discover, however, that this isn't necessary for successful CW decoding.

Please note that we've tested the original and the newest version of this unit, and the ARRL Laboratory test results in Table 1 are for the new version that has additional receiver gain.

The decoder bandwidth is about 120 Hz, and the decoder is programmed to respond to 1300 Hz tones. If you hold down the right or left arrow keys on the keyboard and select a substantial tuning rate, the green **CW IN LED** will flash every time the receiver sweeps across a 1300 Hz tone. The trick is to select a slower tuning rate and then adjust until the decoder locks onto the desired signal and begins flashing in rhythm to the code. You may hear other signals and extraneous noise, but the decoder will ignore it.

Note that there is no opposite sideband filtering, so you will hear received signals above and below the transmit frequency (the frequency shown on the display). As explained in detail in an illustrated appendix in the manual, tune the signal that's lower in frequency to a 1300 Hz pitch for the decoder. The transmit signal will be 1300 Hz above that, at the frequency shown on the display.

As I've often stated in my other writings on this topic, software decoding of over-the-air Morse is always a dicey proposition. It works best when receiving moderate to strong signals sent by polished CW operators. But if an operator's timing varies even a little, or if noise, interference or fading get in the way, all bets are off. What you're likely to see is total gibberish, or a mix of clear text and gibberish. You may also see gaps between individual letters that make visual interpretation a challenge.

The DMX-40 decoder can be used with its built-in transceiver, or you can feed audio to it from an external rig and use the DMX-40 as a decoder only. This is how I ran a test of the DMX-40's decoding performance compared to two Windows applications: *CWTY* by Grant Connell, WD6CNF, and *CWGET* by Sergei Podstrigailo, UA9OV. I tapped

Table 1
PreppComm DMX-40 Morse Code Decoder & Converter Transceiver, serial number 2-1397

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 4.9 – 10 MHz. Transmit, 40-meter amateur band.	As specified.
Power requirement: 7 – 16 V dc.	At 13.8 V dc: Receive: 110 mA (backlight on), 76 mA (backlight off). Transmit, 460 mA.
Mode of operation: CW.	As specified.
Receiver	**Receiver Dynamic Testing**
Sensitivity: 0.3 µV (–117 dBm).	Noise floor (MDS): 7 MHz, –119 dBm.
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range: 20/5/2 kHz offset 7 MHz 71/61/59 dB
Reciprocal mixing dynamic range: Not specified.	Not measured. Low-noise 7 MHz oscillator not available.

ARRL Lab Two-Tone IMD Testing

Band	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
7 MHz	20 kHz	–119 dBm	–52 dBm	67 dB
		–97 dBm	–50 dBm	69 dB

Second-order intercept point: Not specified.	+29 dBm.
IF/audio response: Not specified.	No band-pass filtering or audio filtering.
Transmitter	**Transmitter Dynamic Testing**
Power output: 3 – 4.5 W depending on supply voltage.	7 V dc, 0.5 W; 10 V dc, 1.4 W; 12 V dc, 2.2 W; 13.8 V dc, 3.0 W; 16 V dc, 4.2 W.
Spurious-signal and harmonic suppression: >50 dB.	>50 dB (see Figure A). Complies with FCC emission standards.
CW keying characteristics: Not specified.	See Figures B and C.
Transmitted phase noise: Not specified.	See Figure D.
CW keyer speed range: Not specified.	5 – 60 WPM with supplied keyboard. See text.
Transmit-receive turnaround time: Not specified.	Manual TR switching only.

Size (height, width, depth): 1.5 × 5.5 × 4 inches. Weight, 9 ounces.

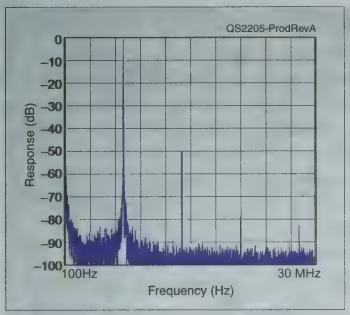


Figure A — Spectral display of the PreppComm DMX-40. Power output is 3 W on the 7 MHz band. This plot shows the output spectrum from 0 to 30 MHz. The second harmonic is down 50 dB from the carrier, and the third harmonic is down 69 dB. The vertical scale is 10 dB per division.

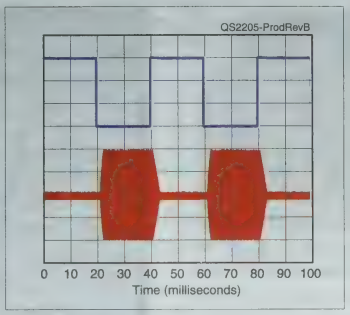


Figure B — CW keying waveform for the PreppComm DMX-40. Equivalent keying speed is 60 WPM using the internal keyer. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 3 W output on the 7 MHz band. Rise time is 1.1 ms and fall time is 2.3 ms. First dit: on delay, 1.6 ms; off delay, 2.4 ms.

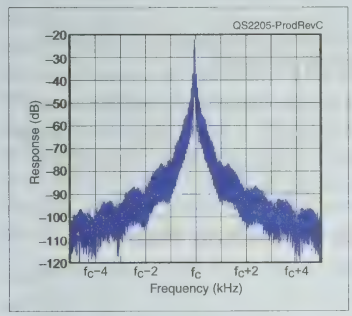


Figure C — Spectral display of the PreppComm DMX-40 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using the internal keyer. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 3 W PEP output on the 7 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

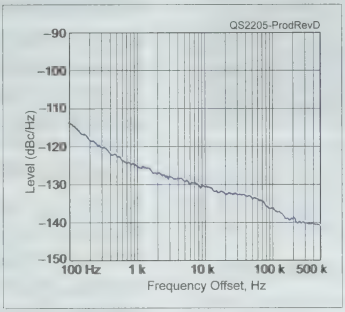


Figure D — Spectral display of the PreppComm DMX-40 transmitter output during phase-noise testing. Power output is 3 W on the 7 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 500 kHz from the carrier. The reference level is –90 dBc/Hz, and the vertical scale is 10 dB per division.

the audio from my primary transceiver and switched it between the DMX-40 and the software running on my PC. This wasn't a scientifically rigorous test, but it provided a useful comparison. While the DMX-40 decoder didn't appear to be superior to *CWTY* or *CWGET*, it kept pace much of the time. And again, remember that the DMX-40's decoder is tirely self-contained within the transceiver — no external computers are required.

By tapping the **ESC** key on the keyboard, you can toggle the decoder between two decoding algorithms: One designed to cope with the variability of human-sent CW, and the other designed for computer-generated code. When using the "human" **HCW** mode, I noticed that the decoder required a few seconds to analyze a new signal before it began decoding. The response was faster in the **CCW** (computer CW) mode.

Making Contacts with the DMX-40

For making contacts with the DMX-40, you have two ways to go about it. You can use the transceiver's keyboard and touchscreen to initiate contacts and enjoy conversations. You can also connect an external key to send CW by hand.

If you have another transceiver (perhaps with higher transmitter power or a more selective receiver), you can use the DMX-40 in **EXTERNAL MODE**, which disables the DMX-40's transceiver functions. Connect the DMX-40's **KEY IN/OUT** and **AUDIO IN** jacks to your transceiver's CW key and headphones jacks, and you can use all of the DMX-40's other features described below to send and decode CW messages using your other radio. The manual cautions that the external radio's bandwidth should be adjusted to a wide enough bandwidth to accommodate the 1300 Hz tone needed by the decoder.

Once again, the DMX-40 is designed for operators who have little or no knowledge of Morse code. To make it as easy as possible for these operators to make successful contacts, the DMX-40 relies on "microprograms," or what digital operators will recognize as "macros" — preprogrammed functions that send specific strings of text. (The DMX-40 microprograms can also perform many other sophisticated tasks.)

For example, if you press the **CALL** button on the touchscreen, the DMX-40 will begin transmitting CQ with your call sign inserted. Once contact is established, you can enjoy a free-form keyboard CW chat or send more microprogram messages.

The DMX-40 Quick Start Guide and the Reference Manual offer detailed explanations about making contacts

Figure 1 — Top view of the PreppComm DMX-40. From left to right we can see the headphone jack, a female SMA 50 Ω antenna jack, and the power connector.

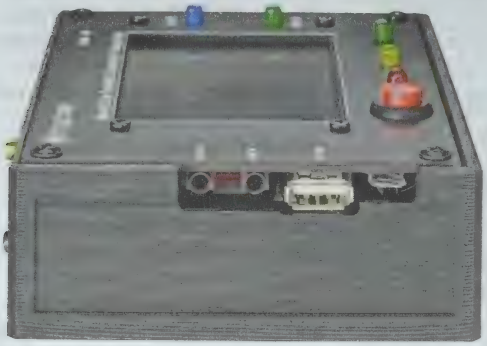


Figure 2 — Left-hand side view of the PreppComm DMX-40. From left to right we can see the key in and out port, the audio in connector, a USB-A connector for a keyboard, and a micro-USB port.

using their microprogram approach. You are also free to set up your own microprograms.

A word of warning, however: if you are an experienced, or even semi-experienced, CW operator, you may often find the operating instructions confusing. This is because they address readers who know nothing about CW communication, and in making the procedures as clear as possible to them the author scrupulously avoids "hamspeak" that amateurs may be accustomed to seeing.

The wording left me momentarily baffled at times, but considering the intended audience, I can appreciate why they chose this approach. The alternative would be having separate sections written for hams who are already familiar with CW communication. My advice to CW aficionados would be to just read between the lines.

Once I realized that the DMX-40 wasn't as complicated as my initial confusion led me to believe, making contacts was straightforward — even with just 3 W output (this can be increased to 4.5 W if you use up to a 16 V supply). The transceiver is intended for emergency,

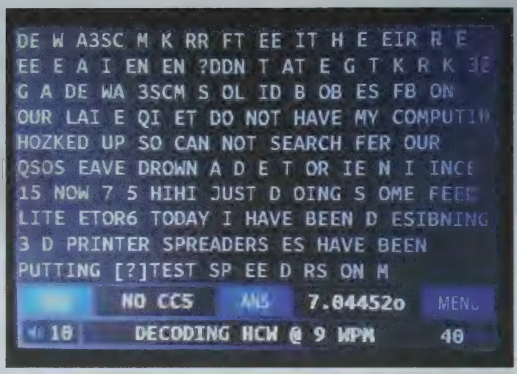

DE W A3SC M K RR FT EE IT H E EIR R E
EE E A I EN EN ?DDN T AT E G T K R K 3E
G A DE WA 3SCM S OL ID B OB ES FB ON
OUR LAI E QI ET DO NOT HAVE MY COMPUTIN
HOZKED UP SO CAN NOT SEARCH FER OUR
QSOS EAVE DROWN A D E T OR IE N I INCE
15 NOW 7 5 HIHI JUST D OING S OME FEE
LITE ETOR6 TODAY I HAVE BEEN D ESIBNING
3 D PRINTER SPREADERS ES HAVE BEEN
PUTTING [?]TEST SP EE D RS ON M
NO CCS
7.04452o
MENU
10
DECODING MCW @ 9 WPM
40

Figure 3 — Decoding a slow Morse exchange on a noisy band with the DMX-40. Decoding improves when you press the space bar on the keyboard, which empties the text cache and resynchronizes.

off-the-grid communication, but I found it to be a fun alternative to traditional operating.

Watch out for the top case plate, which could prevent 3.5 mm plugs from plugging in fully if they have a large barrel. If you use an external key, make sure that the plug will insert all the way in.

The DMX-40 as a Teaching Machine

As many CW operators will attest, there is something about watching decoded Morse that seems to improve one's comprehension. I'm not a high-speed CW speed operator, but as I watched the DMX-40 in action I found that my ability to decode by ear seemed to gradually improve. I soon found myself grasping the characters in my mind before I saw them decoded by the DMX-40.

And while the DMX-40 trains your ears, it can also train your fingers. The rig includes a clever CW sending trainer that allows you to send Morse manually while watching the decoded results on the screen. I plugged in my straight key and proceeded to embarrass myself in short order, but practice makes perfect, and it didn't take long to see an improvement.

Conclusion

The DMX-40 is not for everyone. The target customer is the person who is new to the hobby and who has never communicated using Morse code. Even so, veteran amateurs will likely value the DMX-40's decoding ability and may find that the device offers an intriguing change of pace for casual operating.

Manufacturer: PreppComm; 516 Humbird St., Suite 413, Kootenai, ID 83840; **www.preppcomm.com**. Price: DMX-40, $349. S2X stand, $4.95.

Temperature-Controlled Soldering Stations

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

In looking back at a few old editions of *The ARRL Handbook for Radio Communications*, I've seen perhaps three different soldering irons depicted on a typical radio amateur's workbench. There were the large ones — 80 to 250 W with a ¾-inch diamond-shaped tip — then the soldering guns with one or two heat settings, and finally, the small 25 to 75 W irons, which were mostly used on circuit boards.

Today, soldering integrated circuits, SMDs (surface-mounted devices), and other delicate components on a wide variety of printed circuit board (PCB) materials makes the actual temperature of the soldering iron tip critical. In addition, there is the old 60-40 (or the eutectic type 63-37) lead/tin solder, with a melting point around 361 °F, and the newer lead-free solders, which melt at around 428 °F. Printed circuit board work typically requires soldering iron tip temperatures around 100 °F higher than the solder's melting point.

Even so, the more important number is not the tip temperature, but the temperature of the materials being soldered, for that will determine how well the solder flows and adheres to them. Even if a soldering iron is set for a particular tip temperature, as soon as the tip touches the wire, component lead, PCB, etc., heat draws away from it and the temperature drops initially. If the temperature drops below the melting point of the solder, it will not melt until the tip gets back up to temperature.

A larger tip with more mass will hold more heat and therefore its temperature will dip less, but it might not be practical for use on PCBs with fine traces or components with small, closely spaced, or delicate leads. Modern electronics often require a fine tip.

Another solution is to use a more capable soldering iron with a temperature sensor, which will sense the temperature drop and increase the current through the heating element to compensate. This type of soldering iron may have a fine tip for precision work.

For this review, we looked at three temperature-controlled soldering irons. We checked temperature, safety, and other features using a variety of tip sizes. See the sidebar, "The Importance of Correct Soldering Iron Temperature," for more information about the importance of using the correct soldering iron tip temperature.

Weller WE1010NA

This soldering station, made in Mexico, is sold as a kit consisting of a 120 V digital controller connected through a detachable cable to a soldering iron, allowing replacement of the iron in case of failure. The base holder has a recess to hold a cleaning sponge. One tip is supplied with the iron and an optional kit of five other tips is also available. The tips use an internal temperature sensing element and are not interchangeable with other manufacturers.

The instruction booklet is printed in approximately 26 different languages but unfortunately, only a few pages are devoted to instructions, by way of cartoon drawings, in English. Online information about the use and control of the features is sparse.

The physical size is 5.91 × 4.92 × 3.94 inches. The input supply and connectors are to the North American standard of 120 V 60 Hz, but a European version (230 V / 50 Hz) is available. The iron's power usage is

70 W. It can be set from 200 °F to 850 °F with a claimed accuracy of within ±9 °F and stability of ±10 °F. These numbers are from the manufacturer's online specifications.

Unless you use the smallest tip with a pin-sized end, 70 W is more than enough for most PCB tasks using both lead-based and lead-free solders. (A non-adjustable iron used for PCB work would typically range from 25 to 40 W.) The big question is, can you solder a PL-259 with it? The answer is as expected — no, a larger iron is usually needed.

Controls

The ac line cord plugs into the rear of the control unit. The **ON/OFF** rocker switch is on the lower left of the front panel. To connect the iron's burn-resistant supply cord to the control unit, the two arrows on the connector shell must line up. Then rotate the shell to lock the connector in place. The cord and chassis connectors are keyed to ensure correct orientation.

On the lower right, a pushbutton switch brings up the menu. There are four menu items, which you set using the up and down arrows to the right of the display. Except for a few cartoon drawings, there is no explanation of the settings in the included instruction leaflet.

On turn-on, the up and down arrows set the desired tip temperature. The first push of the menu button brings up the standby time, which is how soon the iron goes into standby, as a safety feature, when it is not in use. The time can be set from 1 and 99 minutes. We tested the standby time by setting it to 2 minutes. After the iron sat unused in the holder for slightly more than 2 minutes, the temperature began to drop to 360 °F, taking slightly over 5 minutes to get there. When we picked up the iron and put it to work, it took only a fraction of a minute to resume the set temperature. The recovery time varied with the temperature set and the heat load of the item being soldered.

In standby, the display shows the set temperature in small numerals below the standby temperature (360 °F). A blinking indicator in the upper left tells you that the unit is in standby. The standby temperature is not adjustable.

The next menu position selects the temperature offset. The instruction book specifies a selectable temperature offset range of –72 to +72 °F but does not explain its use. Some explanations found online (but not on the Weller website) seem to say that when an offset is selected, the actual tip temperature will be the set temperature *plus* the offset amount. This feature was not tested.

The next menu button push sets all temperature displays to Fahrenheit or Celsius (F or C).

The final menu setting, indicated by a small padlock symbol on the lower right of the display, lets you lock the settings for a set time, selectable from 1 to 999 minutes.

In Summary

On the positive side, you could unpack this unit from the box, plug it in and, except for setting the time to go into standby, you could be soldering with a known temperature in just a few minutes. The automatic standby feature is a good idea. Tip change is easy and requires no tools.

On the other side, the instructions are sketchy and the web pages and YouTube videos do not answer many questions.

Manufacturer: Weller; **www.weller-tools.com**. Available from Amazon. Weller WE1010NA, Price: $105. WE1010 Soldering Tip Set (ETSET-5). Price: $35.

Hakko FX-888D

If you want a colorful unit that will decorate your workbench in addition to providing a selectable temperature, you might want to pick this artistically colored and shaped unit.

It comes as a complete kit, including a digital controller and an iron with a pluggable cable, as shown in the photo. The on/off rocker switch is mounted on the right side and there is a permanently installed 120 V line cord in the rear.

The detachable 70 W iron plugs with a keyed connector into the front panel, below the three-digit temperature display. The decimal points in the display

indicate modes and status. For example, when the soldering iron tip reaches the set temperature, the rightmost decimal point blinks to indicate readiness.

The iron holder base has two tip cleaners — a sponge with a small reservoir of water beneath it, and a brass wool bundle inside the base. One tip is supplied with the kit, and a set of additional tips is available. The tips are not interchangeable with those of other manufacturers. The temperature sensing element is part of the handle assembly, and the tip fits over it. Tip change is very similar to that shown for the Weller unit — again, no tools are needed.

In the box is a foldout leaflet of instructions; more on this later. The base size is approximately 3.9 × 4.7 × 4.7 inches, and the weight is about 2.6 lbs. Electrostatic protection, as specified by the manufacturer, is from having less than 2 Ω resistance from the tip to ground, and no more than 2 mV from tip to ground.

The settable temperature range is given as 120 to 899 °F, with stability of ±1.8 °F when set to the range of 400-899 °F. This temperature range, controlling a 70 W iron, provides enough heat for leaded and non-leaded solder PCB work and other small jobs, but not for a PL-259.

Performance is like the Weller unit for heating time, recovery, and response to a change in the temperature setting. The menu is numerical, so you might want to make a tip sheet to guide yourself through.

Controls

When the iron cable is plugged into the front panel and the power is turned on, the unit responds with three 8s in the digital display. It then resumes the temperature set before it was last turned off; the display shows this temperature. The instruction sheet supplied with the unit describes in detail how to select the temperature you want using the two buttons on the front panel — **UP** and **ENTER**.

The leaflet does not describe other available functions, but it contains a web address (**https://doc.hakko.com**) where you can download a complete instruction set. Unfortunately, you must go through a multi-step registration process before it allows you to receive the rest of the instructions.

The full instruction booklet has a page on parameter setting, which you enter by holding the **UP** button as you turn the controller on. Settable parameters include temperatures displays in F or C, as well as an error message display if the tip sensor temperature drops below a preset limit.

The controller can store up to four temperature presets that can be set or recalled by the front panel pushbuttons. The settings can be protected by a password.

In Summary

It is very easy to set the desired temperature on this system, and it has the added security of optional password protection to lock out unauthorized tampering with the settings.

The full instruction booklet has all the needed information but requires extensive user registration, including name, address, email, and telephone number. Without registration, some needed information is locked out and unavailable.

Manufacturer: Hakko; **www.hakkousa.com**. Available from Amazon. Price: $133. Set of six tip pieces, Price: $13.

Merece ST-2090DS

This import from China comes as a complete package, at the lower end of the price range of similar units. Included is a digital controller, with a hard-wired 120 V line cord and a 65 W temperature-controlled soldering iron. Five assorted tips are included, plus one preinstalled in the iron. The five are stored on the right side of the controller. On the left side is a mount for a roll of solder (not included). A well on the lower right contains a clump of brass wool to clean the tip;

The Importance of Correct Soldering Iron Temperature

Applying the correct temperature to solder joints can make the difference between having a solidly constructed project in hand or a disaster. In general, lead-based solder (usually called 60/40 because it is 60% tin and 40% lead) requires a tip temperature of 460 °F, and lead-free solder requires about 100 degrees higher. The composition of lead-free solder is roughly 99% tin, 0.7% copper, plus various trace metals. The temperature-controlled soldering irons in this review are capable of producing tip temperatures over 800 °F, so proper temperature adjustment is needed.

There are two common problems with incorrectly controlled soldering iron temperature. First, as seen in Figure E, an inexpensive, poorly made printed circuit board (PCB) can literally be burned and its copper traces and pads lifted up or even destroyed. The burn mark shown in the photo is due primarily to a poor-quality PCB and a tip temperature set for lead-free solder.

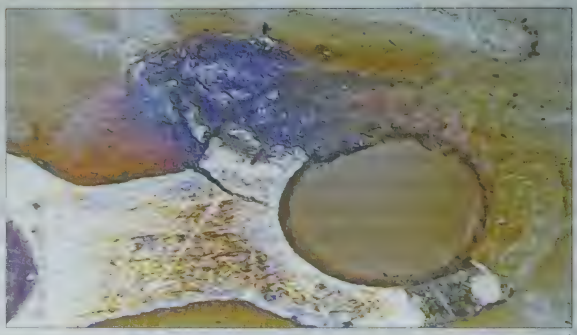


Figure E — This microscope image shows a damaged PCB. The burn is the result of a tip temperature set for lead-free solder, used on a board of poor quality.

Before we look at the other common problem, let's examine a good solder joint in Figure F. Those colors you see are not actually in the joint; a good solder joint is shiny, so what you see in the photograph is a reflection of the microscope and microscope light used to capture the picture. At the proper temperature, solder will flow easily on the wires and surfaces and will adhere well when it cools. Because copper dissolves in melted tin, the solder will form a thin layer of Cu/Sn alloy where it meets with copper, forming an excellent electrical bond.

Figure F — This microscope image shows a good, shiny solder joint.

Figure G is another poor joint, made with lead-free solder but with a 600 °F tip temperature — that is, for leaded solder. That's not quite hot enough for the solder to flow and adhere well. In a joint like this, there may be electrical contact right after construction, but after some time the contact will break (a "cold solder joint") and this defect may not be visually obvious when troubleshooting the problem. Even worse, the joint may become intermittent, making it even harder to spot.

Figure G — This microscope image shows a poor joint, made with a 600 °F tip temperature (suitable for leaded solder), but with lead-free solder.

It's also important to note that solder has very little mechanical strength and will cold-flow if it is stressed; even a joint soldered at a proper temperature can crack, compress, or pull apart if it is subjected to mechanical stress. Therefore, it is good practice to make sure component leads, wires, etc., are securely wrapped or bent or otherwise anchored to the surface they will be soldered to before they are soldered.

The photographs were taken with a KKmoon 600X digital microscope, as reviewed in the January 2019 issue of *QST*.

if you want to use the included mini sponge instead, the pad on the lower right is designed to have a sponge sit in it.

The temperature sensor and heating element are part of the soldering iron assembly; tips are changed by unscrewing a barrel or sleeve with finger pressure — no tools are needed. At a line voltage of 110 V the iron is rated at 65 W. This should be sufficient for most printed board soldering projects, but again not suited to soldering a PL-259. Accuracy is stated by the manufacturer as ± 3.6 °F, over a settable temperature range of 176 to 896 °F. The knob on the front panel is used to set the temperature with a three-digit LED readout.

The manufacturer's instructions consistently misidentify the digital display as a Nixie tube display — apparently a translation difficulty. The size and weight of the unit are not specified but are roughly the same as the other two units tested for this review.

Controls

The power switch is on the top of the control unit. Above the temperature control knob are LEDs to indicate degrees F or C.

Under the temperature control knob is a small push-button that selects temperature units (F or C), and has several other functions. The instructions call it the **LOCK** button. Under some lighting conditions, the button may be hard to see.

On this unit, the soldering iron holder is part of the control unit. Both the small tip cleaning sponge and the brass wool ball are included in the kit of parts. Unfortunately, the sponge is held in place only by friction, so it tends to fall off.

The tips shown are included. When mounting them for the first time, they require a bit of force to set into the holder, but subsequent mounting is much easier. The solder roll holder is a **U**-shaped metal bracket, with a double bend or offset on one side. It comes unassembled to the control unit, so you mount it using a small Phillips-head screwdriver. I used a tiny piece of modeling clay to hold the screws on the screwdriver tip to start them.

Including a set of tips is a bonus, compared to the cost of extra ones (as much as $20) for other soldering iron systems. One of those included is a knife-edge tip, which I use to cut the outer insulation from various types of coax: one cut around the cable circumference and then a lengthwise cut from there to the end of the coax, and the insulation falls off without nicking or damaging the braid underneath.

There are several modes controlled from the front panel using the **LOCK** button and the temperature control knob. The set temperature can be locked or unlocked. If the iron is not used for 10 minutes, it goes to standby mode, and if unused for 20 minutes, it goes into auto-sleep.

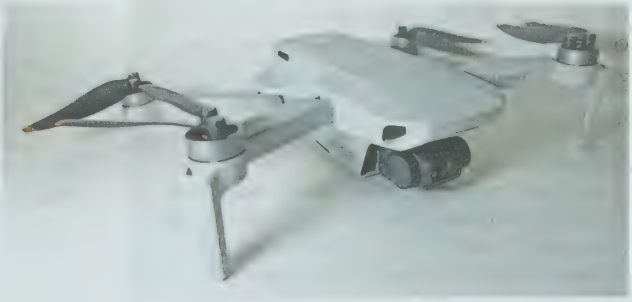
Summary

The Merece ST-2090DS is available at only about one-third the price of many competing models while providing similar control modes, temperature presets, and a temperature range. As an extra bonus, it includes a variety of extra tips and storage, two tip cleaners, and a solder roll holder.

Manufacturer: Merece Store. Available from Amazon. Price: $50.

DJI Mini 2, 4K Video Drone

Reviewed by Pascal Villeneuve VA2PV
va2pv@arrl.org



You're probably wondering, "Why review a drone in *QST*?" Ask yourself, is a drone useful to amateur radio? How about for inspecting antenna/tower infrastructure? If you're like me and not too much of a climber, the answer is well, yes! Many of you already know I'm also an amateur videographer, so there were a few criteria that I was looking for in a drone. First, it had to be easy to fly so

I could concentrate on shooting video. Second, it had to support 4K (2160p) video resolution (four times more pixels than full HD, 1080p). The third criterion was inflight video stability. There was also concern about regulations, but more about this later.

DJI is probably the best-known brand among videographers. Since 2013, they've been adding models, and their Mini series now makes it more affordable for the general public. The DJI Mini 2 is an upgrade from their first model, the DJI Mini, which didn't support 4K video and was less capable in windy conditions. Because the Mini 2 suits all my needs, I bought one.

Safety and Regulatory Concerns

I started to monitor the drone industry in 2015 or 2016, but as drones gained popularity and people started flying them anywhere just for fun, the authorities started raising safety concerns. They then began regulating unmanned aircraft systems (UAS).

The new technologies posed a possible risk both for aerial traffic and for people, animals, and property on the ground, so new laws were passed. In Canada, you now need a pilot's license if the unit's mass is more than 250 grams (8.8 ounces). Flying in certain conditions requires that you register your drone. The DJI Mini 2 is advertised as less than 249 grams (8.78 ounces) with the battery; mine is 239 grams (8.4 ounces) with the battery installed, leaving some room for add-on accessories like a neutral density (ND) filter. Therefore, the model requires no license and has fewer restricted fly zones. The Canadian regulations mainly require that you have the drone in sight all the time while flying, do not exceed the maximum altitude of 400 feet (120 meters) — or lower in some areas — and keep a safe distance of 98 feet (30 meters) from any people not participating in the activity. There are also rules covering flying at night, crossing over public roads, and flying over restricted areas (airports, military bases, etc.).

This review is not the place for covering the regulations in full detail; it is the responsibility of all drone owners, licensed or not, to comply with local regulations before any flying attempt. Keep in mind that regulations may change from time to time, so please do your homework before buying and flying a drone.

Bottom Line

The DJI Mini 2 offers high-quality video and photo capabilities that rival more expensive drones. It's easy to fly, and its small size makes it less restricted by regulations.

The US authority on this matter is the Federal Aviation Administration (FAA), whose regulations for this category of drone are largely similar to the ones we have in Canada. There are some differences to be aware of, so please visit **https://www.faa.gov/uas**. One major difference in the US is that if you are monetizing your drone videos (for example, on YouTube), or if your drone video is used to enhance or promote your business in any way, you must have a Part 107 Remote Pilot license before you take flight; this rule is mandatory for all drone pilots, even those with drones under 250 grams. The FAA established the Recreational UAS Safety Test, a free online training and test module, which is mandatory but reportedly easy and can be done on the *FAA*-approved platform. For more information on this requirement, visit **https://www.faa.gov/uas/recreational_fliers**. Keep in mind that violating local regulations may have severe consequences.

There is nothing wrong with flying over your own house, but if your neighbors' backyards are visible, please respect their privacy. Better yet, tell them you will be flying your drone; they might ask for your help inspecting their roof or gutters, and they might even discover that it's fun.

Figure 4 — The DJI Mini 2 Fly More Combo.

Package and Accessories

When I bought my DJI Mini 2, Amazon offered only two option packages: just the drone and the bare minimum for flying, or the "Fly More Combo." The drone-only package comprises the DJI Mini 2 with one battery and just the necessary accessories to make it fly; you would have to charge the battery directly in the drone. A battery will last about 20 to 31 minutes, depending on the flying conditions. For me, 25 minutes has been about the maximum.

The Fly More Combo (see Figure 4) interested me especially because I wanted a spare battery. The package includes the aircraft, the remote controller (RC), three batteries, spare rotor blades, a USB-C cable for charging, a gimbal protector, three RC adapter cables for almost any type of smartphone (USB-C at one end; USB-C, MicroUSB, and Apple Lightning at the other), spare control sticks, a mini screwdriver, and a two-way charging hub (supports three batteries but charges one at a time; it can also be used as a portable USB power pack), the DJI charger, and a shoulder bag.

Description and Technical Capabilities

The DJI Mini 2 fits in the palm of your hand and folds for transport or storage (5.4 × 2.3 × 2.0 inches, folded), but don't underestimate it. Its 12 MP (megapixel) camera is capable of 4K video and photos, which it can capture in JPG and in RAW format. With a quality, high-speed microSD card installed (not included), it can record 4K video up to 30 fps (frame per second) with a maximum bitrate of 100 Mbps.

When flying, the DJI Mini 2 transmits live 720p video to your smartphone. DJI OcuSync 2.0 technology allows the system to adjust automatically between two frequencies (2.4 GHz and 5.8 GHz), which extends the drone's maximum transmission distance up to 6.2 miles (10 km) from the RC, so you don't have to worry about losing contact with your drone if you keep it in sight. I didn't test how it reacts to nearby RF, which it could be exposed to at a Field Day event.

The maximum speed flight in sport mode is 35 mph, but the unit can still shoot stable video, thanks to its excellent 3-axis camera gimbal stabilizer. It can resist level 5 winds (up to 24 mph) and take off at a maximum altitude of 13,123 feet (4,000 meters), so your footage is stable even when flying along a windy coastline or high above a forest.

The drone's safety features include GPS and a return-to-home button on the controller in case you lose sight of it, which is easy to do because it is so small, and at the 400-foot maximum altitude, you might not be able to hear it, either. It has sensors underneath to prevent crash landings but no lateral sensors like the more expensive DJI drones have. So program a minimum flight altitude before you press that return-to-home button (mine is set to 100 feet, so when I press the return-to-home button, the drone climbs to that altitude before returning to its takeoff position, then it descends). It's also wise to use a foldable landing target, about $10 to $20 on Amazon, which would keep the rotors from cutting the grass when landing, and from whipping up dirt and dust into the motors. The Mini 2 doesn't have a follow-me feature.

Flying the DJI Mini 2

To fly this unit, you need a smartphone with the DJI app installed (Android or iOS) and connected to the remote controller. My iPhone 11 Pro Max fits into the RC's extensible support (see Figure 5), but it's tight, so it's probably the maximum size it will accommodate.

Figure 5 — The iPhone Pro Max attaches to the DJI Mini 2 remote controller while the drone is hovering at low altitude and streaming the live video to the iPhone.

Figure 6 — A close capture of VA2PV's antenna, from a 4K video taken with the DJI Mini 2.

The user-friendly DJI app will prevent taking off in a restricted zone. Its restricted zones, however, include buffers around the ones designated by the authorities. This is by design; you can fly in these buffer zones if you use the app to unlock your drone; it will connect to your DJI account and use your cell phone to send you a code for unlocking your drone. Thus, they will have a log of your flight with all the details, associated with your personal information. You assume the responsibility. If the drone reaches the border of a no-fly zone, it will stop. My home is far enough from the closest airport but is still within the app's buffer zone. So every time I fly, I must unlock the app, and my drone is limited to 25 meters (82 feet) altitude. This is more than enough for inspecting my antennas and my roof, though (see Figure 6).

For your first flight, you should find a wide-open field where flight is permitted. Make sure there are no obstructions and the weather is appropriate (i.e., a sunny day with no wind). I recommend doing a manual liftoff (follow the DJI tutorial) and having it hover at low altitude in camera mode. If you lose control, simply let go of the control stick; the drone will instantly stop and hold its position. Then resume moving the drone slowly. You will find after two or three flights that it's very easy.

Ham Radio Applications

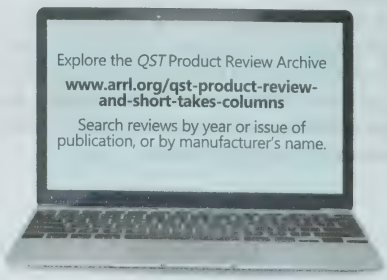
The DJI Mini 2 is so easy to fly that you can get quite close to your antenna infrastructure, and with its 4K resolution camera, you can even zoom in post-production (on PC editing software) without losing too much quality. The camera has a 4× digital zoom, but I found that zooming in post loses less image quality. Even in a small wind, the drone is so stable that viewing the horizon with no motion in the field of view looks like a still picture. But when shooting a close-by object, such as inspecting my antenna, the image reveals some motion even in light wind, especially with the digital zoom. The result is very usable anyway.

Another application for this drone could be to pass a small wire through a tree, as for a temporary or permanent dipole. The payload is limited to 2.9 ounces (82 grams), though, and you must not exceed 8.8 ounces (250 grams) total.

Conclusion

Should you buy a drone just for ham radio applications? Probably not; you'll surely want to use it recreationally, too. It would be a great tool for a local club with at least one qualified licensed pilot, who could help members with their antenna inspection. Still, it's something cool to play with and if you're like me, it's probably already on your wish list anyway.

Manufacturer: DJI; L.A., California, USA; **www.dji.com**. Available from Amazon and local electronic stores. Price: DJI Mini 2 only, $449. DJI Mini 2 Fly More Combo, $599.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Dave Casler, KEØOG, askdave@arrl.org

Ask Dave

Get more information from the "*QST*: Ask Dave" YouTube playlist at **https://bit.ly/3z2MBMI**.

Grounding Matters, Balun Decisions, and the Long and the Short of Waves

Corralling the Grounds

Q John Powell, KF6EOJ, asks: My HF vertical and 2-meter J-pole antennas are both tied to the ground rod at the base of the HF vertical. My J-pole on the roof is also strapped to a galvanized vent pipe that ties to the under-house cast-iron sewer line. At the rig, which has only the coax shields tying it to ground, I have an MFJ tuner on the HF line. It has its own braided ground line tied to a copper water line near the house, which has all-copper plumbing, except for the line to the street. At the plumbing entrance there's another ground rod tied to the water line. Given all that, will I have problems? Everything seems okay, except I can't tune all bands on my HF vertical, a Hustler 6BTV.

A I think you answered your own question. You're not able to tune your Hustler antenna on all the bands that it's capable of using. I suspect the reason is because you have stray RF radiation interacting with your radio and tuner.

Grounding and Bonding for the Radio Amateur by Ward Silver, NØAX, is now in its second edition and is available at **www.arrl.org/shop**. This book will give you current amateur best practices for grounding. If you have more exotic grounding questions, consult a licensed electrician who has experience with communications facilities.

Let's get your shack straightened out first. You should have, outside your shack, an 8-foot ground rod driven into the Earth. Ground strap or braid should be connected to this, and travel via a short route to your shack. Use something such as a 1-foot piece of copper pipe as your shack single-point ground. Attach, using ground braid or strap, every item in your shack to this short piece of copper pipe. I suggest using hose clamps to attach to the pipe. Ground lines should never be soldered, but should be of the clamp or crimped variety. Attach your power supply, radio, antenna tuner, and any other shack equipment that deals with RF (such as switches) to this single-point ground.

The next step is making sure that all coax from all antennas is brought to the ground rod. You should put in high-quality lightning surge arrestors, such as the ones made by Alpha Delta, for each line. So if you have two outdoor antennas, you will have two surge protectors. From there, bring the coax into your shack and attach it to your radios.

From your ground rod, you will want to bond (connect) to your copper water pipe under the house, as well as to the ground rod at the electric utility entrance to the house.

As for grounding the antennas themselves, just make sure that these various grounds are bonded to your station ground rod via a #6 bare copper wire, if possible.

Note that over the last several years, the amateur radio community's understanding of grounding has evolved, in some ways significantly, and will continue to do so. The National Electric Code® for residential use does not really contemplate the idea of several amateur radio antennas and transceivers. Commercial RF installations have additional guidance. Figuring out exactly what to apply to amateur radio has been a difficult challenge, sometimes resulting in rather heated debates. If you follow the guidelines given here, in addition to what you've already done, there's a good chance you will find that your tuner will be more effective, and you will have less noise in your received signals.

To Balun or Not to Balun

Q Don Tolson, VE7ATJ, asks: I'm in the process of building a fan dipole in my attic for 80 through 6 meters. Should I put a balun in the line? If so, should I put it at the dipole feed point or at my antenna tuner?

A There are two schools of thought regarding baluns and dipoles. Clearly the feed point is a place where you might expect to find a balun, given that the antenna is balanced and coax is not. One way to feed the antenna is directly, with a balanced feed line such as window or ladder line, then putting the balun at the antenna tuner, if the antenna tuner does not already have one. The other way is to put the balun at the feed point and use coaxial cable for feed line.

The other school of thought — and I tend to lean this way — is to forget the balun entirely. Just connect the coax to the antenna and go with that. People will vigorously argue both

ITU Frequency Bands			
Extremely low frequency	ELF	3 – 30 Hz	100,000 – 10,000 km
Super low frequency	SLF	30 – 300 Hz	10,000 – 1,000 km
Ultra low frequency	ULF	300 – 3,000 Hz	1,000 – 100 km
Very low frequency	VLF	3 – 30 kHz	100 – 10 km
Low frequency	LF	30 – 300 kHz	10 –1 km
Medium frequency	MF	300 – 3,000 kHz	1,000 – 100 m
High frequency	HF	3 –30 MHz	100 –10 m
Very high frequency	VHF	30 – 300 MHz	10 – 1 m
Ultra high frequency	UHF	300 – 3,000 MHz	100 – 10 cm
Super high frequency	SHF	3 – 30 GHz	10 – 1 cm
Extremely high frequency	EHF	30 – 300 GHz	10 – 1 mm
Tremendously high frequency	THF	300 – 3,000 GHz	1 – 0.1 mm

points of view. If you put your antenna up and have trouble in the house with radio frequency interference, then by all means, put that balun in. I would recommend feeding it with coaxial cable from the radio to the antenna, which will help the feed line radiate less. If you have RFI problems, add the balun. Good luck with your project!

What's a Long Wave vs. a Short Wave?

Q Tom L., a shortwave listener, asks: With the upheavals in Europe, I'm trying to listen on my shortwave. I've looked at the internet (for example, at **www.shortwaveschedule.com**) for frequencies, and I find references to longwave. Can my shortwave receiver get longwave? Isn't WWVB on longwave?

A Words like "shortwave" and "longwave" reference frequency bands. Longwave, more formally called "low frequency," is the band from 30 kHz to 300 kHz or 10,000 meters to 1,000 meters. Navigation and other beacons can be found in this band too. Note that there is one low-frequency amateur band: 2,200 meters. The longwave AM broadcast stations were once popular in Europe because of the greater groundwave distance traveled. Under normal conditions, these are not audible in the US. The medium frequency band is from 1,000 meters to 100 meters, or 300 kHz to 3 MHz. This includes the American AM broadcast band. Stations in this band operate during the daytime using ground-wave propagation, and are usually heard city-wide. At night, clear channel stations can be heard at a long distance of 2 to 3,000 miles. The high-frequency (HF) band is 3 MHz to 30 MHz, or 100 to 10 meters. The term "shortwave" usually includes all of HF and the top portion of the medium-frequency (MF) band. In the US, there are amateur bands at 160, 80, 60, 40, 30, 20, 17, 15, 12, and 10 meters. In addition, there are amateur bands at very high frequencies, ultra high frequencies, and even higher.

Most radios designed for shortwave listening will cover the MF AM broadcast band and all of shortwave. In addition, many include the very-high-frequency FM broadcast band, and often other VHF channels such as weather broadcasts. Many shortwave radios do not include the low-frequency bands unless they are designed for a European market.

There is a lot to learn about successful shortwave listening. Check out my video on the subject, at **youtu.be/vYX3y9GZDdg** (Ask Dave #352), to help point you in the right direction.

WWV is the US time and frequency station that broadcasts on 2.5, 5, 10, 15, 20, and sometimes 25 MHz. WWVB is a high-power station in Fort Collins, Colorado, that transmits on 60 kHz. It uses this low frequency so that the ground wave can cover most of the continental US. This station is used by so-called "atomic" consumer clocks to keep accurate time. WWVB has been in operation in its present location for over 60 years, and provides time service for an estimated 50 million clocks and watches in the US alone. For more information about WWV and its broadcasts, read "The Heartbeat of the Shortwaves" by Jen Glifort, KC1KNL, in the March 2022 issue of *QST*.

Send your questions to **askdave@arrl.org**, or fill out the form at **www.ke0og.net/ask-dave**. I answer some questions here, and some via videos on my YouTube channel (**www.youtube.com/davecasler**), or during my weekly livestream on Thursdays at 6:45 to 8:15 PM Mountain Time on my channel.

Hints & Hacks

Repurposing PC Cases; Crafting a Microphone Adapter Cable

Old PC Cases Revisited

I recall a past *QST* article regarding the use of old computer cases for project boxes. It showed a linear amplifier configured in a PC tower or mini-tower case. Years ago, I put a pair of 4X150s with a Pi-El output, power supplies (2 kV, 300 V, –50 V), fans and blowers, in an old ITT XTRA PC desktop case. It still serves as my station's backup and medium power amp, delivering 400 – 500 W. Figure 1 shows the interior of the amplifier. It was a very tight fit, a mechanical challenge, and a rewarding result.

I would like to extend the idea of using various PC parts as chassis boxes in building projects. PC power supply cases make excellent containers for many projects. Figure 2 shows several examples, including a remote control for an antenna switch, antenna rotator control, and two bench power supplies.

The power supply cooling fan and power connector may be left in place if needed. The line voltage select switch can be replaced with an on/off slide switch. It is sometimes necessary to cut out grill openings and re-panel the front and rear of the chassis with aluminum sheet or Lucite® plastic for mounting of connectors and controls. Rubber feet can be added to the bottom of the case to keep it from sliding around and scratching a desk surface.

If the PC power supply is still in working order, it can make a useful bench power supply. It is usually necessary to provide a light load of about 10% on the +12 and +5 supplies to maintain proper regulation of the outputs.

CD and DVD cases can also become shielded containers for items such as circuit boards. Figure 3 shows one such CD case with the CD components removed. The front and rear of the case have been closed with aluminum panels so that connectors and controls can be mounted.

That old PC that you were about to toss can live again with good metal (or plastic) working skills, imagination, and patience. — *73, Don Opdycke, KT3V,* **don.opdycke@gmail.com**

Figure 3 — A CD/DVD case with the components removed.

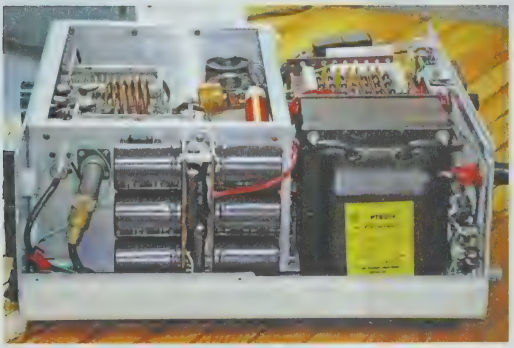

Figure 1 — An old PC case repurposed as an enclosure for the author's homebrew amplifier.

Figure 2 — PC power supply cases put to use as enclosures for a remote control for an antenna switch, an antenna rotator control, and workbench power supplies.

A Better Desk Microphone Cable

We can probably all agree that there have not been many positive things to come out of the COVID-19 pandemic. However, one of the few good things for me was to get reacquainted with ham radio after being off the air for a few years. Unfortunately, I sold all my HF gear a few years ago, so I needed to find a new radio.

After some research I purchased the Icom IC-7300 transceiver. After using the IC-7300 with the Icom SM-30 desktop microphone for a few months, I noticed that I kept hitting the microphone connector because it protruded several inches from the front panel. I was afraid I would eventually damage the connector, and it also interfered slightly with my access to the volume/squelch control. Also, because I have limited desk space in front of the radio, I just didn't like the cable sticking out so far from the front panel (see Figure 4).

I searched all the usual places for an adapter cable that would simply connect to my existing SM-30 microphone cable and terminate in a female 90-degree eight-pin connector that I could plug into the front panel connector. Surprisingly, I couldn't find the cable adapter I was looking for.

I decided I would simply replace the existing straight connector on the SM-30 cable with a 90-degree connector, and after some online searching, I located the necessary connectors.

Figure 5 — The finished adapter cable.

However, after receiving the connectors, I again decided I didn't want to modify the existing SM-30 cable because it was under warranty. Changing the connector on the SM-30 is obviously the cheapest solution, if you don't mind modifying your microphone cable.

My ultimate solution was to buy an eight-pin microphone extension cable online that had male and female straight connectors for simply extending the existing cable. I would retain the straight male connector, but would replace the female connector with the 90-degree connector.

The extension cable I found was a 24-inch coiled cable, but because I wanted the adapter cable to be as short as possible, I simply cut the cable about 6 inches from the male connector end, right before the coils began.

Replacing the connector was straightforward (see Figure 5). I only connected the five wires that are used for the SM-30 desktop microphone, not all eight that are used with the handheld microphone that comes with the IC-7300. To do this, I identified the three unused wires and cut them back when preparing to install the new 90-degree connector. The arrangement worked perfectly (see Figure 6).

Although this example highlights the IC-7300 transceiver, you can add a similar adapter to almost any radio.
— *73, Scott Eckert, KK6DZ,* **sbeckert@verizon.net**

Figure 4 — The SM-30 desktop microphone connector protruded a few inches from the transceiver's front panel, making it difficult to access the volume/squelch control.

Figure 6 — Thanks to the adapter cable, my SM-30 desktop microphone can connect to my IC-7300 transceiver without the plug getting in the way.

"Hints and Hacks" items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given hint will work for your situation, we make every effort to screen out harmful information. Send technical questions directly to the hint's author.

QST invites you to share your hints with fellow hams. Send them to "Attn: Hints and Hacks" at ARRL Headquarters, 225 Main St., Newington, CT 06111, or via email to **hh@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and email address on all correspondence. Whether you are praising or criticizing an item, please send the author(s) a copy of your comments.

Technical Correspondence

Easier Receiver Calibration; Testing Start/Run Capacitors; A Two-Frequency Vertical

Receiver Calibration Without Test Equipment

Here are two ways to calibrate the frequency of your transceiver or receiver without the use of a frequency counter, oscillator, oscilloscope, or any other test equipment. The first method works with any radio having two variable frequency oscillators (VFOs) that work off the same oscillator, which includes just about any radio sold in the last 25 years. For this explanation I will use WWV on 10 MHz, but it will work with any other frequency standard station such as the other WWV frequencies (2.5, 5, 15, or 20 MHz) or CHU (3.33, 7.85, or 14.67 MHz).

Using a narrow filter, tune in WWV's carrier in CW or lower sideband mode on VFO A. On lower sideband, you should hear the carrier as a 700 Hz tone at 10.000.700 MHz. If your radio does not display 1 Hz resolution, tune it to the point at which the frequency readout flips between 10.000.69 and 10.000.70 MHz. In CW mode, you should hear it at 10.000.000 MHz or tune to the point where your readout flips between 9.999.99 and 10.000.00 MHz.

Now switch to VFO B and tune in the carrier in CW-reverse mode at 10.000.000 MHz, or 9.999.300 MHz upper sideband (or where it flips between 9.999.29 and 9.999.30 MHz). Then switch back and forth between CW and CW-reverse, or between lower and upper sideband. Both tones should be the same. If they are not, adjust the oscillator until they are. If your radio has dual watch, turn it on. If the two tones are almost the same, you will hear the beat frequency going *wowowowowow*. The frequency error in hertz is half the number of *wows* per second. Adjust your oscillator to slow down the *wowowowowow* until it stops. On most radios, you are adjusting a potentiometer that is mounted directly on the oscillator's circuit board. Be sure not to press too hard with your adjustment tool, or you could bend the pot out of position.

If your radio does not have a second VFO, use a second radio to tune in WWV in AM mode. Then tune it in on your first radio in each sideband mode at 10.000.000 MHz. Use the 500 and 600 Hz tones they broadcast to adjust your radio the same way, adjusting until the *wowowow* stops. In this case the frequency error is equal to the number of *wows* per second.

The best time to calibrate your radio is when geomagnetic conditions are quiet, preferably in the early afternoon or after midnight. If you do it near sunrise or sunset, there may be more than the usual amount of Doppler shift in the tone. Be sure your radio is warmed up first, and your room temperature is normal and stable. This calibration may not be accurate enough to win a frequency measuring contest, but it should be accurate within 1 or 2 hertz. No test equipment required. — *Joe Stern, KI4QG,* **ki4qg@twc.com**

Testing Rotator Start/Run Capacitors In-Circuit

When an antenna rotator fails to turn, or turns sluggishly, the motor capacitor in the control box is often the culprit. But bench testing these capacitors with a simple digital voltmeter (DVM) does not fully rule them out. Testing the motor start/run capacitor in-circuit is more favorable, as the capacitor is under stress because it is passing the full ac load current and has the operating ac voltage across it. Testing in-circuit also saves time because no disconnecting and reconnecting is required.

I recently needed to have a commercial freezer serviced and was intrigued by the testing technique the technician used to in-circuit test the start/run capacitor for the compressor. While the tech said the capacitor was good, he didn't know why the technique worked. I have reverse engineered the

It is reasonable to suspect a failure of the start/run capacitor in an antenna rotator control box when a rotator suddenly fails to turn, but is the capacitor really faulty? An out-of-circuit test won't always provide the answer. In this month's column Glenn Schulz, W9IQ, describes a method for in-circuit testing that will let you know for sure.

method and have found it fully applicable for testing rotator start/run capacitors in-circuit. This technique eliminates any variance from motor inductance, and the resistance of the wiring connecting the control box to the rotator.

With the rotator motor energized and using proper safety procedures for the line voltages that are present:

Step 1. Measure the current passing through the capacitor with a clamp-on ac ammeter. This is typically done on the wire between the capacitor and the rotator motor.

Step 2. Multiply the amps measured in Step 1 by 2,652 (or 3,183 if 50 Hz power).

Step 3. Measure the ac voltage across the capacitor. This may be higher than the transformer voltage.

Step 4. Divide the result of Step 2 by the voltage of Step 3. This is the capacitance of the motor capacitor in microfarads.

For example: 900 milliamps × 2,652/30 volts = 80 microfarads. If this value deviates substantially from the marked capacitor value while allowing for its tolerance range, the capacitor is probably defective and should be replaced.

Note that if no current is measured in Step 1, this could also indicate a broken or disconnected wire, a failed switch, etc. Additional testing is warranted in this case.

The common DVM measures scalar values, therefore the following formulas are all in scalar form.

Capacitive reactance in ohms is given by:

$$X_C = \frac{1}{2\pi fC} \quad (1)$$

where f is the frequency in hertz and C is the capacitance in farads.

Because most motor starter capacitors are in the microfarad range and the frequency in the US is 60 Hz, it is convenient to adjust equation 1 to incorporate these constants:

$$X_C = \frac{1{,}000{,}000}{2\pi 60 C_\mu} = \frac{2{,}652}{C_\mu} \quad (2)$$

where X_C is the reactance in ohms and C_μ is the capacitance in microfarads.

Note that the numerator could rightfully be rounded to 2,653, but the value of 2,652 is generally easier to remember as "26 and double it." The rounding down has no significant impact on the predicted capacitance — particularly considering the large tolerance of motor capacitors.

The relationship of voltage, current, and capacitive reactance is given by Ohm's law as:

$$E = IX_C \quad (3)$$

where E is the voltage in volts, and I is the current in amps.

Substituting equation 2 into equation 3 and solving for C_μ:

$$C_\mu = \frac{2{,}652I}{E} \quad (4)$$

In this final form of the equation, the formal units for the 2,652 constant are microfarads per siemen, while the I/E term is conductivity (the reciprocal of resistivity) in siemens. — *Glenn Schulz, W9IQ*, **w9iq@arrl.net**

A Simple Vertical that Resonates at Two Frequencies

In the second paragraph of the article "3-D-Printed Fixture Simplifies Ground-Plane Antenna Construction," in the June 2019 issue of *QST*, John Portune, W6NBC, makes an elegantly clear statement about the essence of a typical ground-plane antenna: *it is a dipole*.

Although a ground-mounted vertical antenna with a few radials is different, it is also essentially a dipole. Its operating frequency can be tweaked by slightly adjusting either half of the dipole: its height or the length of its radials. This is key to a unique way of establishing two resonant frequencies for one vertical radiator.

Consider a vertical element with length h in feet; $h = 234/f$ (MHz), and f is a frequency midway between the preferred part of the CW band and the preferred part of the phone band. Now, diverging from the typical design, imagine the counterpoise consists of eight radials: four of which are shorter than h, and four of which are longer than h. Long and short radials alternate, evenly spaced, around the feed point.

This antenna was actually constructed. The monopole was made of a swimming-pool skimmer pole and a telescoping antenna from a portable radio. The total height was 16.56 feet. The radials were made of #14 wire, some insulated, some not. Four radials had a length of 16.84 feet, for a total dipole length of 33.40 feet (half-wavelength resonant at 14.01 MHz). Four had a length of 16.28 feet, for a total dipole length of 32.84 feet and half-wavelength resonance at 14.25 MHz.

Obviously, each dipole is fed very slightly off-center, but this causes no problem. With 50 Ω feed line, this arrangement exhibited an SWR minimum (of about 1.5:1) near both 14.01 MHz and 14.25 MHz. As expected, a much higher SWR (and therefore greater cable loss) is measured midway between these frequencies. — *Bob Raffaele, W2XM*, **w2xm@arrl.net**

Technical Correspondence items have not been tested by *QST* or ARRL unless otherwise stated. Although we can't guarantee that a given idea will work for your situation, we make every effort to screen out harmful information.

Materials for this column may be sent to ARRL, 225 Main St., Newington, CT 06111; or via email to **tc@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number, and email address on all correspondence. Whether you are praising or criticizing a work, please send the author(s) a copy of your comments. The publishers of *QST* assume no responsibility for statements made herein by correspondents.

Wheelchair On the Air

This 82-year-old ham turned his electric wheelchair into a mobile station that still allows him the capabilities of folding his chair and taking it with him during air travel.

Cal Myer, AK4QP

Most of my operating time is spent on the SpiderWebNet, a net that operates twice per day at 14.347 MHz. I have an Icom IC-7300 with a Hamstick antenna on the third-floor balcony railing of the assisted care facility that my wife and I reside at in Naples, Florida.

My completed "wheelchair on the air." The radio board pulls forward 6 inches to access the master power switch. My Xiegu G90 is on the left, and my 20 Ah battery is on the right. I also used a double-fused Anderson Powerpole® four-position power distribution block to power my radios and accessories. At the top of my chair, you'll see my bhi NES10-2 MK4 DSP remote speaker and antenna mast mounting tube. My antenna mast easily slides into the oversized mast mounting tube without the use of tools. [Cal Myer, AK4QP, photo]

Being wheelchair-bound led to some ham friends putting the idea in my mind that I was a "mobile" operator. I took that as a challenge, and decided to turn my wheelchair into a mobile station.

Project Requirements

I have an Eagle HD electric foldable travel wheelchair. It weighs 58 pounds with batteries, uses two 24 V dc 6 Ah lithium battery packs, and has an 11-mile range (it expends about 1 Ah per mile). I charge it once a week. At an average wheelchair speed of 3 MPH, it would take 3.66 hours to travel the full 11-mile range.

One of my requirements was that I needed to make sure that I could still fold my wheelchair. The radio electronics also needed to be independent of my wheelchair's electronics. I had an indoor height restriction of 80 inches to allow for doorway passage, and the mast/antenna system needed to be easily removable and transportable.

Choosing the Right Equipment

I chose the Xiegu G90 HF 20 W transceiver based on what I read in "Product Review" in the March 2020 issue of *QST*. At 5.7 pounds, it's small, has an internal antenna tuning unit (ATU), a detachable control head, and an optional cooling fan bracket. The transceiver is easy to use and has a small screen that shows at least as much information as my IC-7300.

For my battery, I went with the Bioenno Power 12 V dc 20 Ah BLF-1220A, at 5.4 pounds. This lithium iron phosphate (LiFePO4) battery's separate terminal pigtail allows for easy recharging that's independent of radio power connection. At the G90's maximum draw of 5 A, a duty cycle of 5%, and a 95% receive draw of 0.5 A, there's enough power for me to operate for 13 2-hour SpiderWebNet sessions.

Because I was mounting the radio under my wheelchair seat, I needed a remote speaker. The Xiegu G90 only has a 0.5 W speaker output. Reading the May 2021 issue's "Product Review" led me to purchase the bhi NES10-2 MK4 DSP noise canceling speaker, as it's small and has a 5 W amplifier. It nearly eliminates all

For air travel, the radio board is pulled out completely. A single release lever on my wheelchair allows it to fully collapse. [Cal Myer, AK4QP, photo]

static and hiss, and is the perfect companion to the needs of my G90.

A Laborious Construction

In constructing my station, I began by attaching the Xiegu G90's control head to my wheelchair's left armrest, and the speaker and antenna mounts onto the seat back rail. I then attached the G90's body and battery to a 12 × 12 × ½-inch plywood base weighing about 13 pounds. Next, I screwed a 10-inch drawer slide to the bottom of the plywood base, before finally attaching the mating slide to the lower chair frame.

The construction was somewhat difficult because I only had access to simple hand tools at the assisted care facility. It took me nearly a year of tinkering and trying a variety of components before everything fit and worked as I had hoped.

Mobile Operations

When I'm traveling in the elevator from my third-floor apartment to go outside for my radio operations, I simply hold the Hamstick in my lap. My removable 45-inch aluminum antenna mast stays in its mounting tube. Once I'm outside, I pull the antenna mast out of the mount and attach the antenna using quick disconnects. While sitting in my wheelchair, I simply reinsert the bottom of the mast, complete with antenna, into its mounting tube (no tools are required). The top of my 20-meter antenna reaches a height of about 16 feet, and my wheelchair serves as the counterpoise. I ended up having to cut my antenna mast from its original length of 48 inches, because it didn't allow enough clearance for the automatic door mechanism at my assisted care facility.

To operate my transceiver, I just slide open the radio board that's under my seat to access the master power switch. Then I slide it back under the seat.

For air travel, I pull the radio board out completely and collapse my wheelchair. The two lithium battery packs (totaling 12 Ah) built into the wheelchair reach the maximum Federal Aviation Administration (FAA)

Here, my 20-meter Hamstick is fully erected at approximately 16 feet high (I marked the tip with white tape). [Jim Carrender, K3AVR, photo]

My Xiegu G90 control head is at an easy-to-use location for operating. [Jim Carrender, K3AVR, photo]

lithium battery limit. This is also why I need to remove the radio board, as its 20 Ah lithium battery is above the FAA limit.

Results

I've had very good results making RF contacts in the US, Canada, Colombia, Panama, and Costa Rica.

I can use my wheelchair for my handheld 5 W VHF/UHF Icom IC-80AD radio. I have a choice of two dedicated 45-inch antenna masts: one mast is set for my dual-band vertical antenna, and one is for my Yagi antenna (the Yagi tends to draw a lot of attention). Using either antenna on VHF/UHF, I can make contacts in Marco Island, Florida (about 15 miles away).

I hope my story inspires other hams to not let their age or handicap hold them back from completing a special project they've been wanting to try!

Cal Myer, AK4QP, earned his Novice license in 1954, and currently holds an Amateur Extra-class license, but didn't get active with radio until he was about 70 years old. Cal has a BS in Industrial Engineering from the University of Illinois, and he cofounded an advertising supply chain company for a multinational fast-food chain. Cal is a Life Member of ARRL and the Quarter Century Wireless Association (QCWA). He's a descendant of General Albert Myer, founder of the US Army Signal Corps, in Fort Myer, Virginia. Cal can be reached at **calmyer@comcast.net**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Congratulations

February 2022
QST Cover Plaque Award Winner

Joe Reisert W1JR

In his article, "12- and 17-Meter Antenna Design," Joe Reisert, W1JR, presents construction details of a dual-band Yagi antenna that operates on 12 and 17 meters, bands that are not usually covered by widely available triband antennas. The dual-band Yagi uses a direct feed, so no additional impedance matching devices are required.

QST Cover Plaque Awards are given to the author or authors of the most popular article in each issue. *You* choose the winners by casting your vote online at

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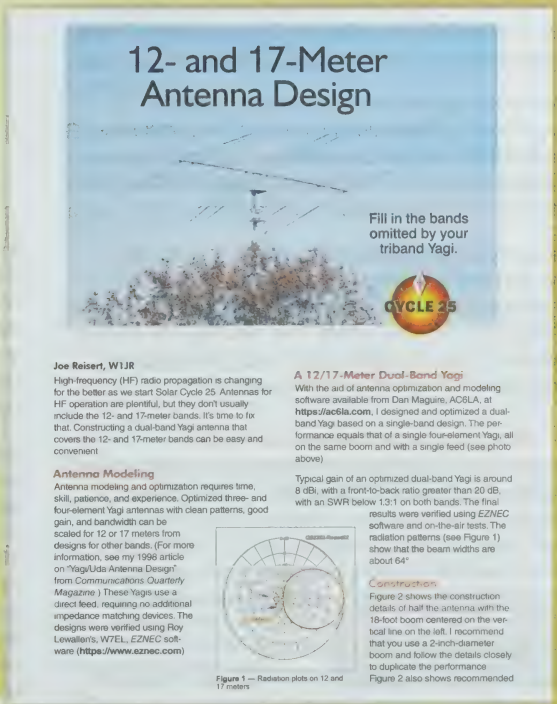

12- and 17-Meter Antenna Design

Fill in the bands omitted by your triband Yagi.

CYCLE 25

Joe Reisert, W1JR

High-frequency (HF) radio propagation is changing for the better as we start Solar Cycle 25. Antennas for HF operation are plentiful, but they don't usually include the 12- and 17-meter bands. It's time to fix that. Constructing a dual-band Yagi antenna that covers the 12- and 17-meter bands can be easy and convenient.

Antenna Modeling

Antenna modeling and optimization requires time, skill, patience, and experience. Optimized three- and four-element Yagi antennas with clean patterns, good gain, and bandwidth can be scaled for 12 or 17 meters from designs for other bands. (For more information, see my 1996 article on "YagiUda Antenna Design" from *Communications Quarterly Magazine*.) These Yagis use a direct feed, requiring no additional impedance matching devices. The designs were verified using Roy Lewallen's, W7EL, *EZNEC* software (**https://www.eznec.com**).

A 12/17-Meter Dual-Band Yagi

With the aid of antenna optimization and modeling software available from Dan Maguire, AC6LA, at **https://ac6la.com**, I designed and optimized a dual-band Yagi based on a single-band design. The performance equals that of a single four-element Yagi, all on the same boom and with a single feed (see photo above).

Typical gain of an optimized dual-band Yagi is around 8 dBi, with a front-to-back ratio greater than 20 dB, with an SWR below 1.3:1 on both bands. The final results were verified using *EZNEC* software and on-the-air tests. The radiation patterns (see Figure 1) show that the beam widths are about 64°.

Construction

Figure 2 shows the construction details of half the antenna with the 18-foot boom centered on the vertical line on the left. I recommend that you use a 2-inch-diameter boom and follow the details closely to duplicate the performance. Figure 2 also shows recommended

Figure 1 — Radiation plots on 12 and 17 meters.

A November Sweepstakes Expedition to Puerto Rico

These two hams made the first-ever Sweepstakes SSB contacts from the island in their category, while having some fun and sun.

Duane Traver, WV2B

Rob Whitmore, AE4X, and I had worked together on a DXpedition to St. Paul Island (CY9) in 2000, and in 2021, we wanted to go on another ham radio expedition together. We thought about going somewhere with a ready-to-operate station, but found a daunting combination of COVID-19 testing requirements, quarantine requirements, approved lodging lists, and budget restraints.

Puerto Rico Possibilities

One place with reasonable travel restrictions was Puerto Rico. Travel was allowed by uploading proof of vaccination to their portal, and it was considered domestic travel. But we didn't know if there would be any interest in a contact with Puerto Rico. After all, it was number 295 out of 340 on Club Log's DXCC Most Wanted List.

We thought about making it a contest operation. It would be a multiplier during a contest — particularly the ARRL November Sweepstakes (SS), where the island counts as an ARRL Section multiplier. The contest was from November 20 – 22, 2021.

Perusing the all-time score records for Puerto Rico revealed that there had never been an entry in the Multioperator, Single Transmitter, Low Power category in SS phone from the island. This would be the perfect category for us, considering we would have to carry almost everything with us on the airplane.

Finding an Operating Location

We booked a small villa-style home near Quebradillas (**www.vrbo.com/3958250ha**) for our operations. It was located on the top of a hill just outside the main town area, and was the last property on a dead-end road. It also had a yard surrounded with trees and offered a clear shot to the ocean only a few miles away.

Antennas and Equipment

Wire antennas seemed to be the easiest to transport and erect for our expedition-style operation. I decided to bring the Delta 7 full wave loop antenna, built by Ralph Capone, W2RPC, which I had been using at home for several months. This antenna gave low standing wave ratio (SWR) across all of 20 meters and was easily matched on higher bands with a tuner. I could easily contact stations I heard from home and hoped for similar results in a portable operation.

Rob, AE4X (left), and Duane, WV2B (right), with their complete Sweepstakes contest station, neatly packed up. The larger gear was mailed ahead to Duane's friend Grisselle, whom they also enjoyed cultural food and drink with on the trip.

For 40 meters, we brought a two-element wire beam antenna based on the design by Bob Glorioso, W1IS, and Bob Rose, KC1DSQ, which appeared as "A Portable Two-Element 40-Meter Wire Beam" in the June 2021 issue of *QST*. But rather than use 10-foot dowel rods for physical support of the beam, we shot two separate lines about 10 feet apart over mango trees on each end. These lines provided physical support for each element. Several collapsible windsock poles were used to maintain proper 10-foot spacing by passing the director wire through the eyelets on the smaller end of

the poles, with the butt end of the poles attached to the driven element with a zip tie and a little electrical tape to keep them from sliding on the wire. These antennas would give us at least a little gain on each band we would operate on during the contest.

Other than our large equipment that we mailed ahead to Puerto Rico, our entire contest station fit into two hard equipment cases. We packed two transceivers just in case: a Kenwood TS-590S and an Icom IC-706MKII. Thankfully we did, because during our operation, the TS-590S wouldn't put out more than 25 W. So, rather than spend time troubleshooting, the Icom became the contest radio by default.

Arrival and Preparation

We arrived in San Juan on Thursday afternoon before the contest, picked up the equipment we had mailed ahead, and went to our accommodation. Friday was spent setting up and testing the station. Saturday was a day to relax, make a few contacts, and get mentally prepared for the contest.

Operating the Contest

We started our operation as AE4X/KP4 with Rob on the radio, while I logged contacts on the laptop. Our headsets were connected so we could both hear the receiver. This allowed the logger to fill in some data while the operator was calling. It became apparent right away that this would be a search-and-pounce contest for us. Attempts to run stations resulted in contacting a station or two, but no continuing callers. Stateside stations were not looking toward the Caribbean.

The daylight hours were spent between 20 and 15 meters, with 40 meters giving the best results in the morning and evening. By late Sunday, it was extremely difficult to find any stations we had not already contacted. We switched operators every hour, searching diligently for contest latecomers or stations we hadn't been able to contact before due to poor conditions or too many other operators calling them.

We missed five ARRL Sections. We heard VI weakly, but never without a pileup, and we couldn't contact them via short skip. We heard NNY several times contacting other stations, but never heard them calling CQ, nor did anyone from that Section call us. We didn't hear any stations from WTX, MAR, or NT.

Contesting from Puerto Rico with wire antennas and low power proved more difficult than I had imagined. It seemed that all directional antennas were pointed away from us, as many operators told us they needed to rotate their antenna in our direction before being able to complete the contact.

The feed point of our two-element 40-meter beam, showing windsock poles being used as spreaders. We built this antenna based on the June 2021 *QST* article, "A Portable Two-Element 40-Meter Wire Beam," by Bob Glorioso, W1IS, and Bob Rose, KC1DSQ.

On the other hand, some contacts seemed very easy. For example, Alaska and Hawaii, which had always been challenging from home, seemed to fall right into the log from Puerto Rico. We ended the contest with 310 contacts and had a lot of fun.

Some Time to Relax

After packing up our equipment for our departure on Tuesday, we spent some time at the beach. We also traveled farther west, where we were able to get a clear view of Desecheo Island (KP5), the 18th most-wanted DXCC entity.

Before we knew it, our adventure was over. While we hadn't set the contesting world on fire, we were able to have fun and make a respectable effort with our old-school, DXpedition-style operation.

All photographs by the author.

Duane Traver, WV2B, was first licensed in 1978 at age 13. Duane is a 20-year employee of the United States Postal Service. Previous DX operations have included WV2B/CY9 and as part of the CY9DH group, FP/WV2B, and as VP2MDT. Duane previously served as an Official Observer and Official Observer Coordinator for the WNY Section before moving to North Carolina. He can be reached at **wv2bduane@gmail.com**.

Rob Whitmore, AE4X, was first licensed in 1984 at age 13. Rob is a 1994 graduate of the Philadelphia College of Pharmacy and is employed as a clinical pharmacist. His hobbies include traveling, camping, and deep-sea fishing. Rob has worked with Habitat for Humanity in Myanmar and Cambodia. He has operated from St. Paul Island (CY9), and enjoys ARRL Field Day, expeditions, and CW operating.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

ARRL Board Meets for First 2022 Session

At its January in-person Annual Meeting, the ARRL Board of Directors elected new officers, approved a new initiative, and gave out awards and recognitions.

Read the full minutes at **www.arrl.org/board-meetings**.

The head table at the January 2022 ARRL Board of Directors meeting included Treasurer Rick Niswander, K7GM; First Vice President Mike Raisbeck, K1TWF; President Rick Roderick, K5UR, and CEO David Minster, NA2AA. [Radio Amateurs of Canada photo]

The ARRL Board of Directors re-elected ARRL President Rick Roderick, K5UR, to a fourth term when it met in-person in Windsor, Connecticut, on January 21 – 22. An attorney from Arkansas, Roderick has served since 2016.

One new face will be among the officers at the next ARRL Board meeting in July. During its January meeting, the Board elected John Sager, WJ7S, of Saratoga Springs, Utah, to succeed Treasurer Rick Niswander, K7GM, on May 1.

Niswander previously announced his decision to retire, after more than 10 years of distinguished service in the volunteer position. His most recent 2-year term as Treasurer expired in January. The Board re-elected him to continue to serve through April 30, 2022, allowing a transition between Niswander and Treasurer-elect Sager.

The remaining officers were all re-elected:

- First Vice President: Michael Raisbeck, K1TWF
- Second Vice President: Bob Vallio, W6RGG
- International Affairs Vice President: Rod Stafford, W6ROD
- Chief Executive Officer (CEO): David Minster, NA2AA
- Chief Financial Officer (CFO): Diane Middleton, W2DLM

The ARRL Board of Directors elected the Executive Committee (EC), which acts in the Board's stead between scheduled Board meetings. The EC consists of the President, five Directors selected by the Board of Directors for 1-year terms, the First Vice President, and CEO. The EC members are:

- President Rick Roderick, K5UR, Chair
- First Vice President Michael Raisbeck, K1TWF
- Atlantic Division Director Tom Abernethy, W3TOM
- Dakota Division Director Bill Lippert, AC0W
- Pacific Division Director Kristen McIntyre, K6WX
- West Gulf Division Director John Robert Stratton, N5AUS
- Great Lakes Division Director Dale Williams, WA8EFK
- CEO David Minster, NA2AA

The Board welcomed first-time members, New England Division Director Fred Kemmerer, AB1OC, and Pacific Division Vice Director Tony Marcin, W7XM. They also welcomed the return of Roanoke Division Director Jim Boehner, N2ZZ.

Finances and Investments

CFO Middleton reported that ARRL recorded a small gain from operations in 2021 and continues to maintain a strong balance sheet, along with healthy cash balances. ARRL continued to experience significantly lower

spending in 2021 due to canceled events and limited travel, along with the timing of filling vacant positions.

During the meeting, the Board agreed that the Investment Management Committee would oversee the transition of ARRL's investment portfolio to a new external investment manager, including oversight of the creation of an agreement between ARRL and the new investment manager. The Board selected CAPTRUST as the ARRL investment manager, "subject to the successful completion and execution of a satisfactory investment management agreement." The Board agreed that a permanent Investment Management Committee be established starting on May 1, 2022, composed of five voting members. The ARRL Treasurer will be an ex-officio member of the committee without vote and will chair the committee. The remaining members of the committee will be two current Directors or Vice Directors and three non-ARRL Board members selected for their investment expertise.

By-Law 38 was amended to say (in part): The Administration and Finance Committee shall, "Advise the Board on all actions and reports of the Investment Management Committee."

ARRL Field Day 2022

In the Program and Services Committee report, Northwestern Division Director Mike Ritz, W7VO, noted that a Field Day survey went out to 15,000 Field Day participants, and a link to the survey was posted on several social media sites, receiving more than 3,000 responses. As a result of the survey, the committee decided that Field Day would be conducted in the same manner as in 2021, with the addition of a 100 W power limit for all participants. The committee said that based on how Field Day 2022 goes, it will discuss continuing the event in this manner going forward.

Clean Signal Initiative

The Board unanimously approved a Clean Signal Initiative, which seeks to engage ARRL Laboratory staff and volunteer technical experts in the ability "to establish formalized technical standards for transmitted signal purity of amateur radio equipment, certify new equipment to these standards, and work with manufacturers to ensure compliance with these standards for the good of amateur radio worldwide." It also requires that ARRL address the educational aspect of transmitted signal purity by developing materials to train amateurs in the proper operation of amateur radio transmitting equipment.

Standing Orders

In its report, the Board's Legal Structure Review Committee said it would be in the best interests of members, the Board, and ARRL staff to impose a more logical organizational structure on existing Standing Orders, to permit easier reference and to form a basis for future updates and modernization. The Board approved a motion that resolved adopting the Standing Orders (as of January 17, 2022) as the current Standing Orders format, to be published on the ARRL website and in any appropriate publications. The entire list of Standing Orders and revisions was attached to the meeting minutes as an appendix.

Life 70+ Membership Program

The ARRL Board agreed to revise the reduced-rate, revenue-neutral Life Membership program for individuals aged 70 or older, to eliminate the requirement that applicants have a cumulative ARRL membership of 25 years or more. Such memberships cost $750.

Emergency Communications and Field Services Committee

The Board tasked the Emergency Communications and Field Services Committee (ECFSC) with developing guidelines that describe "the expected relationship between Division Directors/Vice Directors and the Section Managers and their appointees within the Division." The Board said the intent is "to facilitate effective communications and coordination in both directions between Division Directors/Vice Directors and Section Managers, without interfering with the normal chain-of-command in the Field Organization."

The Board asked ECFSC to provide a progress report at its July 2022 meeting and a draft plan at the January 2023 meeting.

The ARRL Foundation

The Board elected Kermit Carlson, W9XA; David Minster, NA2AA; Central Division Director Carl Luetzelschwab, K9LA, and re-elected Northwestern Division Director Mike Ritz, W7VO, to the ARRL Foundation Board of Directors.

ARRL Foundation Director, Atlantic Division Director Tom Abernethy, W3TOM, reported that the ARRL Foundation had $7.2 million in assets. This included $1.1 million in the Goldfarb Scholarship endowment, and it is anticipated that the 4-year scholarship will be awarded this year. A total of 122 scholarships, valued at $564,250, were awarded this past year. This included seven new annual scholarships created by donors ranging from $1,000 to $5,000 each.

Amateur Radio Digital Communications (ARDC) scholarship funding has steadily increased each year and is expected to be $900,000 in 2022. ARDC has also awarded $500,000 to create an ARRL club grant program and $100,000 for the setup and administration of the program. The program will make grants of up to $25,000 available to clubs.

Greetings and Salutations

International Amateur Radio Union (IARU) President Tim Ellam, VE6SH, extended greetings on behalf of the IARU's officers. Ellam noted that International Telecommunication Union (ITU) officers will be elected this fall for the next 4-year cycle. Doreen Bogdan-Martin, KD2JTX, current Director of the ITU Development Sector, is the leading candidate for ITU Secretary-General.

Ellam noted that IARU Region 1 held a Shaping the Future Workshop, which generated in-depth discussions on how IARU needs to change to meet new challenges in amateur radio. "Amateur radio is very diverse now, and the goals of the IARU are to meet the needs of diverse member-societies and their members," he said.

Radio Amateurs of Canada (RAC) President Phil McBride, VA3QR, brought greetings from the RAC as its new President. McBride said RAC's 2021 meeting was canceled due to the COVID-19 pandemic. RAC continues to offer online classes, and more than 1,000 students completed the basic class, while 500 completed the advanced course. "A goal of RAC is to expose youth to amateur radio," he said.

Newly re-elected ARRL President Rick Roderick, K5UR (left), and newly elected RAC President Phil McBride, VA3QR/VA3KPJ, at the January 2022 ARRL Board of Directors meeting. [Radio Amateurs of Canada photo]

Awards and Recognitions

- The Board expressed deep appreciation to Frederick Niswander, K7GM, for his 10 years of dedicated service as the volunteer ARRL Treasurer. The Board thanked him and wished him all the best in his future endeavors.
- The Board expressed gratitude to retired ARRL Headquarters staff member Dan Henderson, N1ND, for his 23 years of service to ARRL and its members. They congratulated him on his retirement and wished him continued success.
- The Board congratulated Dr. James Jolly, W6RWI, on his 100th birthday and honored him with the ARRL Centurion Award.
- Upon the recommendation of an ARRL panel of technical advisors and the ARRL Board's Programs and Services Committee, the Board awarded the 2021 Doug DeMaw, W1FB, Technical Excellence Award to Richard Kiefer, KØDK, for his article, "Eliminating Radio Frequency Interference from Power Lines," which appeared in the September 2021 issue of *QST*.
- The Board expressed its sincere gratitude to and commended ARRL Louisiana Section Emergency Communications Coordinator Jim Coleman, AI5B, the Louisiana Amateur Radio Emergency Service® (ARES®) membership, and all supporting ARRL members and radio amateurs involved in the Hurricane Ida response.

The Board recognized and congratulated several ARRL Affiliated Clubs for attaining significant milestones:

- Huron Amateur Radio Club (South Dakota) for its contributions to amateur radio on its 100th year of ARRL affiliation, and on its 100th anniversary.
- St. Cloud Amateur Radio Club (Minnesota) for its contributions to amateur radio on its 100th year of ARRL affiliation, and on its 105th anniversary.
- Winona Amateur Radio Club (Minnesota) for its contributions to amateur radio on its 75th year of ARRL affiliation.
- Twin City DX Association (Minnesota) for its contributions to amateur radio on its 50th year of ARRL affiliation.
- Jamestown Amateur Radio Club (North Dakota) for its contributions to amateur radio on its 75th year of ARRL affiliation.
- Black Hills Amateur Radio Club (South Dakota) for its contributions to amateur radio on its 85th year of ARRL affiliation.
- Hot Springs Amateur Radio Club (South Dakota) for its contributions to amateur radio on its 60th year of ARRL affiliation.
- Southeastern Massachusetts Amateur Radio Association for its contributions to amateur radio on its 75th anniversary of ARRL affiliation.
- Santa Clara County Amateur Radio Association (California) on its 101st anniversary.
- Stanford Amateur Radio Club (California) on its 100th anniversary.
- Capitol City Amateur Radio Club (Montana) on its 75th anniversary.
- Valley Amateur Radio Club (Washington) on its 75th anniversary.

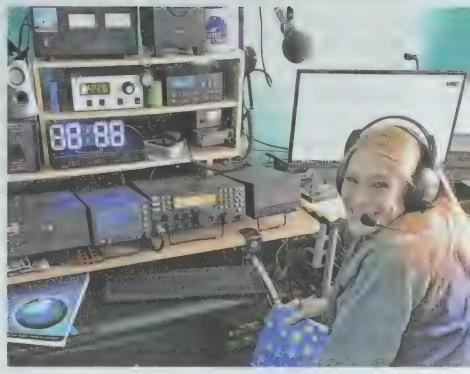
The ARRL Ham Radio Equipment Insurance Plan

This policy covers radios and related equipment, with a lower deductible than most homeowners policies.

There are all kinds of ways to lose valuable gear in an instant. ARRL offers a ham radio equipment insurance plan as a benefit to members. Through this insurance, members can cover all of their equipment at a low price and ease their fears.

Tom McDonough, Senior Vice President of Risk Strategies Insurance, Inc., is the broker and administrator for this program with ARRL. He said, "The equipment insurance plan covers your radio equipment and all related equipment — whether you include computers, portable gear, miscellaneous cables and accessories, handhelds, etc."

The insurance covers mobile and home station equipment from damage by fire, lightning, wind, collisions, theft, and other accidents or natural hazards. It also covers loss or damage to antennas, towers, and rotators.



The insurance coverage available to ARRL members can help safeguard your equipment in the event of theft or damage. [Photo courtesy of Ron Wilcox, KF7ZN]

ARRL Insurance Plan vs. Homeowners Policies

McDonough explained how the ARRL insurance plan compares to homeowners policies:

> The premium is based on a rate well below typical homeowners policy rates, and the deductible of $50 to replace and $25 to repair, is far below the deductible on most homeowners policies. Your homeowners policy is protecting you from a major economic loss — such as a fire — to your home. That is why most homeowners policies have minimum deductibles of $500 per claim. You can reduce premiums by having a $1,000 deductible on your homeowners policy, and even more if you raise it to $2,500 or higher. This will save you on premium costs while still protecting you from the catastrophic loss due to a fire or damage from a fallen tree. The downside of that is your radio transceiver or other station equipment can be worth less than the homeowners deductible, and if lightning strikes, burning out the equipment, you could be faced with a significant expense to replace the equipment and get back on the air. Insuring the equipment in the ARRL program may help you reduce your premium on your homeowners policy and give you coverage that would not be available under the homeowners policy, because the deductible alone would prevent a covered claim.

The annual premium for this plan is just $1.40 per $100 of replacement cost value (with a minimum premium of $20), whereas other coverage available typically runs from $5 – 8 per $100 of replacement cost value. The plan doesn't cover normal wear and tear on the equipment, dishonest acts by the policyholder, and other similar situations that are excluded in the policy.

How to Enroll

The ARRL Ham Radio Equipment Insurance Plan is available to all ARRL members who live in the United States. To enroll, visit **www.arrlinsurance.com**, where you can sign up, schedule your equipment, and pay your premium using a credit card or check. Make sure you list all radio equipment in use and its replacement value.

You must notify the plan administrator (Risk Strategies) of new equipment within 60 days of acquisition. With no additional premium, coverage for up to $2,000 of new equipment is included until your next renewal date. For assistance, please call Risk Strategies' toll-free number, 866-819-0209.

Protection begins as soon as the premium is processed. For more information, visit **www.arrlinsurance.com**.

Rick Lindquist, WW1ME, ww1me@arrl.org

Happenings

"We Will Have Hamvention," General Chairman Pledges

In case you missed the earlier announcement, Dayton Hamvention® 2022 is on, Hamvention General Chairman Rick Allnutt, WS8G, announced in March. Allnutt said it's been a pleasure to assure everyone that Hamvention 2022 is a go.

Hamvention tickets are available on the Hamvention website (**https://hamvention.org**). Hamvention, an ARRL-sanctioned event, will be held May 20 – 22, at the Greene County Fairgrounds and Expo Center in Xenia, Ohio.

Hamvention will feature ARRL EXPO, a large assembly of ARRL-sponsored exhibits and activities, as well as representatives for ARRL programs and services. Several ARRL-sponsored presentations and forums will be given. Information is posted at **www.arrl.org/expo**.

Allnutt and Michael Kalter, W8CI, were interviewed in a DX Engineering YouTube video (**www.youtube.com/watch?v=vTDZqVgPLgE**) in February and unveiled the official logo for Hamvention 2022. This year's theme, "reunion," celebrates the return to a world of hams getting together after missing two Hamventions, and commemorates the history of Dayton Hamvention, which stretches back 70 years to 1952.

"The community is very excited about things. There have been improvements made at the Expo Center, and they're totally on our side working with us," Kalter said. "It's [going to] be wonderful," Allnutt told DX Engineering's Tim Duffy, K3LR.

Kalter also highly recommended attending Contest University (CTU) on May 19, the Thursday before Hamvention, at the Hope Hotel.

Volunteer Monitor Program Cautions against Operating Beyond License Privileges

Many of the Advisory Notices sent out each month by the ARRL Volunteer Monitor Program go to stations heard operating outside the operator's license privileges. While some may be doing so deliberately, it seems that many of these instances reflect a lack of clarity regarding the Part 97 — Amateur Radio Service rules.

Typical cases often involve operators holding Technician- or General-class amateur licenses being heard on a frequency or band not permitted by their license privileges. Most recent incidents have frequently entailed FT8 digital mode operation by Technician licensees on 20 and 40 meters. Technician licensees do not have any operating privileges on 20 meters, let alone digital privileges, and FT8 is a digital protocol.

Technicians (and Novices) may operate CW between 21.025 and 21.200 MHz on 15 meters, from 7.025 and 7.125 MHz on 40 meters, and from 3.525 to 3.600 MHz on 80 meters, but they do not have any digital (data) mode privileges on these bands.

ARRL Volunteer Monitor Program Administrator Riley Hollingsworth, K4ZDH, said licensees who need a refresher course regarding their operating privileges may refer to Section 97.301 of the rules. ARRL also has a convenient chart on its website (**www.arrl.org/graphical-frequency-allocations**) that details privileges available to all license classes, from Novice to Amateur Extra.

As monthly Volunteer Monitor reports indicate, some General-class operators have lost their way on some bands too, and Advisory Notices have gone out to those operating outside of the General-class phone subbands. For example, on 20 meters, Generals may operate phone from 14.225 to 14.350 MHz, but occasionally, General-class operators are heard outside of that subband. On 40 meters, the phone and image subband open to General licensees is 7.175 to 7.300 MHz. Of course, Technician- and General-class licensees may operate

CW on any subband on which they have operating privileges, although operation within the CW subbands is preferred by band plan.

On 10 meters, Technicians have RTTY and data privileges — including FT8 — from 28.000 to 28.300 MHz, and SSB phone privileges from 28.300 to 28.500 MHz, and may operate on CW over the entire 28.000 – 28.500 MHz segment. Technicians may enjoy all operating privileges at 50 MHz and above.

The ARRL Volunteer Monitor Program is a formal agreement between the FCC and ARRL. In this program, volunteers trained and vetted by ARRL monitor the airwaves and report evidence that may be used to correct errant operation or to recognize exemplary on-air operation.

HamXposition to Host ARRL New England and Hudson Division Conventions

In what may be a "first," the Northeast HamXposition will host both the ARRL New England and Hudson Division conventions this year. HamXposition takes place August 26 – 28, 2022, in Marlborough, Massachusetts, and tickets are available May 1.

Formerly known as "Boxboro," the New England Division Convention features a Saturday morning keynote address, Friday and Saturday evening banquets with guest speakers, a large outdoor flea market, and ample indoor vendor space. Proceeds from the convention will benefit scholarships for both New England and Hudson Division students. Volunteers and speakers will be drawn from both Divisions.

"It certainly has been a while since the Hudson Division has had a convention," said ARRL Hudson Division Director Ria Jairam, N2RJ. "By joining forces with the New England Division for a joint convention, we can bring back a sense of nostalgia and community."

New ARRL New England Division Director Fred Kemmerer, AB1OC, said, "We are excited to have the Hudson Division join with New England to support and grow the 2022 HamXposition event." Kemmerer called it "a great opportunity to expand HamXposition participation and programs, and [to] work to provide support for the scholarships to young hams in both Divisions."

HamXposition will return to the venue selected for last year's event — the Best Western Royal Plaza Hotel & Trade Center in Marlborough. Visit the convention website, **https://hamxposition.org**, for more information.

Virginia Gets New Section Manager in Latest Round of Balloting

Balloting for two Section Manager (SM) positions took place over the winter in Virginia and North Carolina. Votes were counted at ARRL Headquarters on February 22.

In Virginia, Jack R. Smith, KE4LWT, of Ruckersville, Virginia, was declared the winner of the Virginia SM contest with 889 votes to 412 for challenger Terry Buzzard, KA8TNF, of Virginia Beach. Smith began his first 2-year term on April 1.

New ARRL Virginia Section Manager Jack Smith, KE4LWT.

Smith previously served for 2 years as an Assistant Section Emergency Coordinator. A US Army veteran, he has extensive emergency management experience. Smith takes the reins of the Virginia Field Organization from Carl Clements, W4CAC. Clements was appointed in mid-December 2021 as interim SM after the passing of SM Joe Palsa, K3WRY.

In North Carolina, incumbent SM Marvin Hoffman, WA4NC, of Boone, received 1,235 votes to win a new term. Challenger Tony Jones, N4ATJ, of McAdenville, received 257 votes. Hoffman began his second term on April 1.

These incumbent SMs faced no opposition and were declared re-elected and will begin new terms on April 1: George Miller, W3GWM (Eastern Pennsylvania); John Fritze, K2QY (Eastern New York); John Mark Robertson, K5JMR (Louisiana); Joe Speroni, AHØA (Pacific); Dave Kaltenborn, N8KBC (San Diego), and Chris Stallkamp, KIØD (South Dakota).

ARRL Seeks Exemption from Proposed US Forest Service Communication Facility Fees

ARRL filed comments with the US Forest Service (USFS), seeking an exemption for amateur radio facilities to a proposed new $1,400 annual administrative fee. The USFS proposal resulted from requirements in the Agriculture Improvement Act of 2018 (also known as the Farm Bill), which directs the USFS to collect fees for issuing communications use authorizations based on the cost to the agency for processing the applications, maintenance, and other related activities. The proposed fee would have to be paid in addition to existing fees — which generally have been around $130 – 140 annually for amateur uses.

"Although the discussion put forward by the Forest Service in its proposal focuses on commercial uses, the proposal would sweep within its requirements amateur radio uses that are solely noncommercial," ARRL said in comments filed on February 22.

"Non-commercial and uncompensated communication uses by radio amateurs within Forest Service areas [have long] served the public interest in many ways, among them by providing the means for otherwise unobtainable emergency communication capabilities in times of need," ARRL noted. "Amateurs perform this valuable public service without cost to taxpayers."

ARRL stressed that equipment, maintenance, and other costs associated with amateur radio facilities on USFS lands "are borne solely by the volunteer radio amateurs themselves."

ARRL continued, "Commercial applicants usually request more extensive use of the lands administered by the Forest Service, and these requests necessarily result in more complex issues having to be considered and resolved."

"In short, the proposal to include volunteer uncompensated amateur service applicants with the commercial wireless service and broadcast applicants is grossly inequitable," ARRL concluded. "There is a disparity in the [number] of resources necessary to consider applications from radio amateurs, as compared to that required by commercial applicants. These dissimilarities in complexity and scope should be recognized in this fees proposal and amateur radio applications exempted."

Section Manager Nomination Notice

To all ARRL members in Connecticut, Idaho, Minnesota, North Dakota, Ohio, Oklahoma, Puerto Rico, Southern Florida, US Virgin Islands, and Western New York. You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the Sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Field Services Manager, the original documents are received by the manager within 7 days of the request. It is acceptable to submit signatures that have been sent via email or mail under the following guidelines: The petition copies must be made from the original form supplied by ARRL or downloaded from the ARRL website. The form must be exactly the same on both sides (i.e., autobiographical information should appear exactly the same on all copies). All forms/copies must be submitted together.

Candidates may use any of the available electronic signature platforms such as DocuSign, HelloSign, and Signed PDF. Candidates who use an electronic signature platform to be nominated, as described above, do not have to send in original paper copies of the nominating documents. The packet that is sent to ARRL Headquarters must be complete. Multiple files or emails for a single petition will not be accepted.

We suggest the following format:

(Place and Date)

Field Services Manager, ARRL
225 Main St.
Newington, CT 06111

We, the undersigned full members of the _____ ARRL Section of the _____ Division, hereby nominate _____ as candidate for Section Manager of this Section for the next 2-year term of office.

(Signature _____ Call Sign _____ City _____ ZIP _____)

Any candidate for the office of Section Manager must be a resident of the Section, an amateur radio licensee of Technician class or higher, and a full member of ARRL for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on June 10, 2022. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters no later than July 1, 2022, to full members of record as of June 10, 2022, which is the closing date for nominations. Returns will be counted on August 23, 2022. Section Managers elected as a result of the above procedure will take office October 1, 2022.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a 2-year term beginning October 1, 2022. If no petitions are received from a Section by the specified closing date, such Section will be resolicited in the October issue of *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. A Section Manager vacancy occurring between elections is filled through appointment by the Field Services Manager. — *Mike Walters, W8ZY, Field Services Manager*

Rick Palm, K1CE, k1ce@arrl.net

A Recap of the ARRL National Convention Emergency Communications Academy

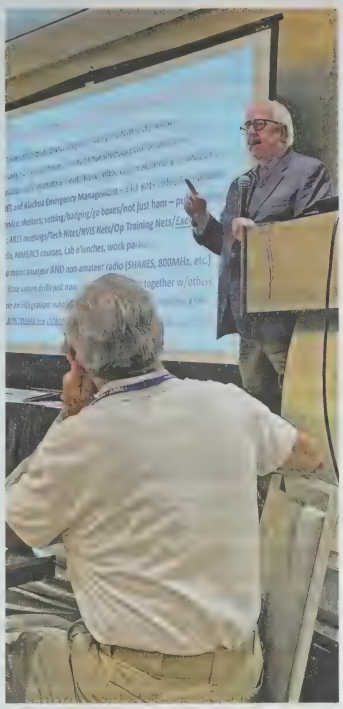
Just over 120 radio amateurs with ties to various organizations and aspects of the emergency communications sector packed the room for the ARRL Emergency Communications Academy on February 10. Sponsored by ARRL and DX Engineering, the day-long session was held in conjunction with the ARRL National Convention at Orlando HamCation®. Subject-matter experts from a diverse array of emergency and disaster communications communities served as panelists and instructors.

ARRL Field Services Manager Mike Walters, W8ZY, acted as the staff liaison for the session, and the new ARRL Director of Emergency Management Josh Johnston, KE5MHV, was introduced. ARRL Section-level officials, including Northern Florida Section Emergency Coordinator (SEC) Arc Thames, W4CPD, and West Central Florida SEC Christine Duez, K4KJN, represented the Amateur Radio Emergency Service® (ARES®) and other organizations and programs, such as the Community Emergency Response Team (CERT), and discussed plans and issues in their respective Sections and areas of expertise.

C. Matthew Curtin, KD8TTE, opened the session with "Hands-On Voice Traffic," a dynamic overview of amateur radio responses to disasters and how communication works through layers of networks and interchanges. (Curtin also provides training videos on YouTube, at **www.youtube.com/c/KD8TTE**.) ARRL Northern Florida Section Traffic Manager Helen Straughn, WC4FSU, along with Curtin, covered basic voice radiogram message transfers and how to input radiograms into the ICS-213 form, the message format employed in the Incident Command System (ICS). A simulated net session conducted by Curtin, Straughn, and Leland Gallup, AA3YB, demonstrated message transaction practice, from message origination to sending, receiving, and delivery.

Discussing the Importance of CERT

As part of "ARRL ARES Forum: What is ARES; How to Join; Open Forum," Duez presented on the West Central Florida Section's CERT program, specifically the Polk County Fire Rescue CERT. The CERT program educates volunteers about disaster preparedness for the hazards that may impact their area, and trains them in basic disaster response skills, such as fire safety, search and rescue, team organization, and disaster medical operations. Duez also spoke of the importance of relationships between clubs and counties within Sections. "We often miss the variety and skills a Division or Section has to offer, and operate as isolated entities," she said. "Building Sections into teams creates mutual support and allows each ARES member to contribute vital skills that will benefit the whole during emergencies." Their next ARRL Simulated Emergency Test (SET) will focus on all counties working together in a declared disaster for the benefit of one or more counties experiencing disastrous conditions.



During the AUXCOMM forum, former FEMA Administrator Craig Fugate, KK4INZ, talked about the criticality of communications — if there's no communication, executing the other emergency support functions is effectively impossible. [Rick Palm, K1CE photo]

Thames announced a statewide survey of ARES groups for Emergency Operations Center (EOC) station capabilities. He also offered tips and tricks for successful ARES programs.

The AUXCOMM Forum

Gallup conducted the "AUXCOMM — Integrating Amateur Emergency Service Groups Open Forum" with state emergency management officials from Florida, Georgia, and elsewhere, as well as the federal government. Florida's newly appointed Statewide Interoperability Coordinator (SWIC) and Georgia's AUXCOMM (Auxiliary

Communications) coordinator presented their visions for radio amateurs serving in state EOCs. Other panelists and attendees included two AUXCOMM course trainers, a visitor from the US Department of Homeland Security's (DHS) Cybersecurity and Information Security Agency (CISA) emergency communications department, and a two-term former Federal Emergency Management Agency (FEMA) administrator, among others.

They offered a look into the future of radio amateurs' roles in state government emergency management, specifically with state-level EOCs and the possible training requirements leading to credentialing hams for state EOC access. State planning staff are considering requiring a volunteer operator to complete a series of learning and training programs, starting with the now-familiar basic FEMA Independent Study courses, followed by the CISA Auxiliary Emergency Communications course, check-off of the items in the *Auxiliary Communicator Position Task Book*, and finally, receiving credentials by the specific state emergency management agency to be served.

The Auxiliary Communicator (AUXC) is a relatively new position that's intended to be part of the Communications Unit (COMU) of the ICS. It was emphasized that the training, certification, and credentialing sequence described above by the speakers is likely to be limited to service at the state level, such as at the state EOC. Local and county agencies impose their own training requirements and credentialing. It was noted that AUXCOMM isn't a replacement for ARES — rather, it's complementary.

Hands-On Training and Attendee Engagement

Emergency Communications Academy Lead Instructor Gordon Gibby, KX4Z, has galvanized Alachua County, Florida, radio amateurs with his nationally recognized training exercises that are conducted strictly under the ICS protocols. During the session, he led "Discussion, Demonstration of Winlink Emergency Communication Tools." Gibby set up students in the room with the ability to download Winlink, register with the network, and send a short message via Telnet Winlink. Students also had the opportunity to send a live message via Winlink VARA and/or ARDOP to a live RMS (Radio Mail Server). The tasks posed a challenge for many students, but Gibby found that 75 – 80% of the students' laptops displayed Winlink up and running.

Curtin and Gibby gave an educational — and wildly entertaining — demonstration of emergency antennas with guidance on field-expedient antenna systems, near vertical incidence skywave (NVIS) propagation, and RF exposure compliance.

The day concluded with an expert overview of emergency power sources, including the advantages of lithium iron phosphate (LiFePO4) batteries, by Earl McDow, K4ZSW.

An Overall Success

It was a long day for presenters and students alike, but by 5:00 PM, no one had left their seats, which was a sure sign of success and engagement. The panelists and instructors received a standing ovation at the conclusion of the day and were given excellent course evaluations (a 4.4 average out of 5), along with lots of ideas for further improvement on what were very well-regarded talks.

PowerPoint slides and video presentations are available on the ARRL Learning Center's website at **https://learn.arrl.org/learning-paths/emergency-communications**.

Field Organization Reports

February 2022

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll.**

754
WA7PTM

430
WA3EZN

423
W7PAT

405
N9VC

360
AA7BM

327
WA2CCN

315
ND8W

295
W7EES

284
KE8BYC

280
WM5N

264
AD8CM

255
KK6GXG

250
N1UMJ

245
KT2D

210
KD2NMG

205
N5MKY

196
WØPZD

190
AI9F

185
KV8Z

180
KC9FXE
KD2LPM

172
KD8DON

170
WM2C
N2LC

167
KD8UUB

165
W3GWM

160
AG9G
N4CNX
W4DNA

155
W2PH

145
WO2H
N8SY
KE4RS

140
WA1URS
K4IWW

WB9QPM
KB8PGW
KK3F

139
K5OB

135
K9LGU
KA9IKK

132
KT5SR
N2DW

130
AC0KQ
W9GRG
N2JBA
N1LL
WK4WC
KD8ZCM
KW1U

126
KB5PGY

125
K8RDN

124
W9RY
KC8T
KY2MMM

123
KC8YVF

122
WD8USA

121
W3YVQ

120
WC4FSU
KA9QWC
K3JL
WA4VGZ
KM8V
KA9MZJ
KY2D

117
W9EEU
W8IM

116
K8MDA

115
KB1TCE
WB9WKO
W2PAX

110
KDØHHN
WA3QLW
KC8WH
N3SW
WB8TQZ
KB2QO
W2AH
K6HTN
N1IQI

109
N3KRX

106
KD2GRS

104
AC8NP

103
WB8YYS

100
KZ8Q
WB8RJW
KC9UC
KN9P
NX9K
WB8SIQ
AC8RV
KE4DRF
W4CMH
AA3SB
K3YAK
KA2GQQ
KA2HZP
KB1NMO
N1LAH

99
KFØBPN

98
WB4ZDU

95
N2TSO
K1XFC

90
KØWAV
AD4DO
KM4WHO
KB9GO
K7OED
KJ7BHO
WB2JNQ
W4KX
KL7RF
N8MRS
KB8GUN
N9TU
N4ZM
N3XMB
K8ED
KC1KVY

89
NI2W

87
KB8HJJ
KT5EM

84
KA1G
KC1HHO

82
W3CJD
N6IET

81
AB9ZA

80
AJ7B
KF7GC
W9BGJ
W2ITT
W4EDN
W8GSR
KR4ST
KT4WX
N3JET
WB2VUF
KB1NAL
KD2JKV

78
KU1U
WB8R

77
K2IE
K1HEJ

76
AA3N
W3ZR
KC1MSN

75
W4TTO
W5WMC
W4INK
K2MJF

74
K2MTG
WA1LPM

73
K4FHR

71
KC3MAL
W5LIC

70
K6RAU
AE2EY

The following stations qualified for PSHR in January, but were not acknowledged in this column last month: KT2D 240, KD2NM 210, WM2C 162, WO2H 150, KK3F 140, N2JBA 130, W3YVQ, K1XFC 120, K1HEJ 104, AA3SB, KB1NMO 100, NI2W, WDØBFO, N2TSO 90, KAØDBK 85, N3JET 77, K6RAU 72, KB3MXK 70.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AR, AZ, CO, CT, DE, EMA, ENY, EPA, IL, IN, KY, LA, LAX, MDC, ME, MI, MO, NC, ND, NFL, NLI, NM, NNJ, NNY, NV, OH, OR, SFL, STX, TN, SJV, WCF, WI, WMA, WWA, WY.

Section Emergency Coordinator Reports

The following Section Emergency Coordinators reported: ENY, EPA, GA, KY, MDC, MI, MO, NLI, ND, NFL, NNJ, NNY, NV, ORG, SCV, SNJ, STX, TN, VA, VI, WCF, WPA, WTX, WWA, WY.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada, and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

KY2D 1,530, KK3F 1,374, NX9K 1,172, N9CK 788, K6HTN 761, WB9WKO 745, N1IQI 706, KW1U 547, N9VC 506.

KK3F qualified for PSHR in January with 1,743 points, but was not acknowledged in this column last month.

Bruce Draper, AA5B, aa5b.corral@gmail.com

Contest Corral

May 2022

Check for updates and a downloadable PDF version online at **www.arrl.org/contest-calendar**.
Refer to the contest websites for full rules, scoring information, operating periods or time limits, and log submission information.

Start - Finish								
Date	Time	Date	Time	Bands	Contest Name	Mode	Exchange	Sponsor's Website
1	1300	1	1900	3.5-28	AGCW QRP/QRP Party	CW	RST serial class (A/B)	agcw.de/contest/qrp-qrp
2	0000	2	0100	1.8-28	K1USN Slow Speed Test	CW	Name SPC (max 20 WPM)	www.k1usn.com/sst.html
2	1630	2	1729	3.5, 7	OK1WC Memorial (MWC)	CW	RST serial	memorial-ok1wc.cz
3	0100	3	0159	1.8-50	Worldwide Sideband Activity Test	Ph	RS OM/YL/Youth	wwsac.com/rules.html
3	0100	3	0300	3.5-28	ARS Spartan Sprint	CW	RST SPC power	arsqrp.blogspot.com
3	1700	3	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call your call serial name	rttyops.com
4	1200	4	1300	1.8-28	A1Club AWT	CW	RST name	a1club.org/contest/awt
4	1300	4	1400	1.8-28	CWops Test (CWT)	CW	Name mbr or SPC	cwops.org/cwops-tests
4	1700	4	2000	144	VHF-UHF FT8 Activity Contest	FT8	4-char grid square	ft8activity.eu/index.php/en
4	1900	4	2000	1.8-28	CWops Test (CWT)	CW	Name mbr or SPC	cwops.org/cwops-tests
4	2300	5	0300	All	MIE 33 Contest	CW Ph	RS(T) age	www.ztv.ne.jp/isoda/33/annual/44/44rule-e.html
5	0000	6	0300	7	Walk for the Bacon QRP Contest	CW	RST SPC name mbr or power (<13 WPM)	qrpcontest.com/pigwalk40
5	0300	5	0400	1.8-28	CWops Test (CWT)	CW	Name mbr or SPC	cwops.org/cwops-tests
5	0700	5	0800	1.8-28	CWops Test (CWT)	CW	Name mbr or SPC	cwops.org/cwops-tests
5	1700	5	1900	3.5-14	RTTYops Weeksprint	Dig	Other's call your call serial name	rttyops.com
5	1800	5	2200	28	NRAU 10-Meter Activity Contest	CW Ph Dig	RS(T) 6-char grid square	nrrlcontest.no/index.php/nrrl-contests
5	1900	5	2000	3.5, 7	EACW Meeting	CW	RST mbr name EA province or country	eacwspain.es/eacwmeeting
5	2000	5	2200	1.8-50	SKCC Sprint Europe	CW	RST SPC name mbr or "none"	skccgroup.com
6	0145	6	0215	1.8-21	NCCC RTTY Sprint	Dig	Serial name QTH	ncccsprint.com
6	0230	6	0300	1.8-21	NCCC Sprint	CW	Serial name QTH	ncccsprint.com
6	2000	6	2100	1.8-28	K1USN Slow Speed Test	CW	Name SPC (max 20 WPM)	www.k1usn.com/sst.html
7	0001	8	2359	28	10-10 International Spring Contest, CW	CW	Name mbr or "0" SPC	www.ten-ten.org
7	0300	7	0859	3.5-28	RCC Cup	CW Ph	RS(T) mbr or ITU zone	rcccup.ru
7	0800	7	1400	All above 902	Microwave Spring Sprint	All	6-char grid square	sites.google.com/site/springvhfupsprints
7	1200	8	1159	3.5-28	ARI International DX Contest	Ph CW Dig	RS(T) 2-letter Italian province or serial	www.ari.it
7	1200	8	1200	3.5-144	F9AA Cup, Digi	Dig	RST serial	site.urc.asso.fr/index.php
7	1200	8	2359	1.8-50	SKCC Weekend Sprintathon	CW	RST SPC name mbr or "none"	www.skccgroup.com
7	1300	8	0700	1.8-28	7th Call Area QSO Party	CW Ph Dig	RS(T) 7th-area state/county or SPC	7qp.org
7	1500	8	0300	1.8-28	Indiana QSO Party	Ph CW	RS(T) IN county or SPC	www.hdxcc.org/inqp/rules.html
7	1700	8	2359	1.8-VHF	Delaware QSO Party	CW Ph Dig	RS(T) DE county or SPC	www.fsarc.org/qsoparty/rules.htm
7	2000	8	2359	3.5-28	New England QSO Party	CW Ph Dig	RS(T) New England county/state or SPC	neqp.org/rules
8	1000	8	1400	7	WAB 7 MHz Phone	Ph	RS serial WAB square or country	wab.intermip.net/Contests.php
9	0000	9	0200	1.8-28	4 States QRP Group Second Sunday	CW Ph	RS(T) SPC mbr or power	4sqrp.com/SSS/sss_rules.pdf
9	1900	9	2030	3.5	RSGB 80-Meter Club Championship, SSB	Ph	RS serial	www.rsgbcc.org/hf
11	1700	11	2000	432	VHF-UHF FT8 Activity Contest	FT8	4-char grid square	ft8activity.eu/index.php/en
14	1200	15	1159	1.8-28	CQ-M International DX Contest	CW Ph	RS(T) serial	cqm.srr.ru/en-rules
14	1200	15	1200	3.5-28	VOLTA WW RTTY Contest	Dig	RST serial CQ zone	www.contestvolta.com
14	1700	15	0300	7-28	Canadian Prairies QSO Party	CW Ph	RS(T) VE4/5/6 district code or SPC	cpqp.ve6hams.ca
14	2300	15	0300	50	50 MHz Spring Sprint	All	4-char grid square	sites.google.com/site/springvhfupsprints
15	2300	16	0100	1.8-28	Run for the Bacon QRP Contest	CW	RST SPC mbr or power	qrpcontest.com/pigrun
18	1700	18	2000	1.2G	VHF-UHF FT8 Activity Contest	FT8	4-char grid square	ft8activity.eu/index.php/en
18	1900	18	2030	3.5	RSGB 80-Meter Club Championship, Data	Dig	RST serial	rsgbcc.org/hf
19	0000	20	0300	14	Walk for the Bacon QRP Contest	CW	RST SPC name mbr or power (<13 WPM)	qrpcontest.com/pigwalk20
19	0030	19	0230	3.5-14	NAQCC CW Sprint	CW	RST SPC mbr or power	naqcc.info
19	1900	19	2000	3.5-14	NTC QSO Party	CW	RST mbr or "NM" (25 WPM max)	qsl.net/ntc/party.html
21	0300	22	0900	50-1296	SARL VHF/UHF Digital Contest	Dig	RST 6-char grid locator	www.sarl.org.za
21	0600	21	2100	3.5-28	UN DX Contest	CW Ph	RS(T) Kazakhstan district code or serial	undxc.kz/rules-eng
21	0800	21	1959	3.5-28	YOTA Contest	CW Ph	RS(T) age	www.ham-yota.com/contest
21	0800	22	1100	3.5	NZART Sangster Shield Contest	CW	RST serial Branch number (if ZL)	nzart.org.nz/activities/contests
21	1200	22	1200	1.8-28	His Majesty King of Spain Contest, CW	CW	RST EA province or serial	concursos.ure.es/en
21	1200	22	1200	3.5-28	EU PSK DX Contest	Dig	RST EU area or serial	eupsk.club/eupskdx/eupskdxrules.pdf
21	1400	22	0200	1.8-144	Arkansas QSO Party	CW Ph Dig	RS(T) AR county or SPC	www.arkqp.com
21	1600	21	2159	1.8-50	Feld Hell Sprint	Dig	Mbr SPC grid	sites.google.com/site/feldhellclub
21	2100	22	0200	3.5	Baltic Contest	CW Ph	RS(T) serial	lrsf.lt/en/balticcontestrules
23	0000	23	0100	1.8-28	QRP ARCI Hootowl Sprint	CW	RST SPC mbr or power	qrparci.org/contest
25	0000	25	0200	1.8-50	SKCC Sprint	CW	RST SPC name mbr or "none"	www.skccgroup.com
26	1400	26	2200	3.5, 7	QRP Minimal Art Session	CW	RST class number of components	qrpcc.de/contestrules
26	1900	26	2030	3.5	RSGB 80-Meter Club Championship, CW	CW	RST serial	www.rsgbcc.org/hf
28	0000	29	2359	1.8-28	CQ WW WPX Contest, CW	CW	RST serial	www.cqwpx.com
30	1900	30	2030	3.5-14	RSGB FT4 Contest	FT4	4-char grid square	www.rsgbcc.org/hf

There are a number of weekly contests not included in the table above. For more info, visit: **www.qrpfoxhunt.org**, **www.ncccsprint.com**, and **www.cwops.org**.
All dates and times refer to UTC and may be different from calendar dates in North America. Contests are not conducted on the 60-, 30-, 17-, or 12-meter bands. Mbr = Membership number. Serial = Sequential number of the contact. SPC = State, Province, DXCC Entity. XE = Mexican state. Listings in blue indicate contests sponsored by ARRL or *NCJ*. The latest time to make a valid contest QSO is the minute listed in the "Finish Time" column. *Data for Contest Corral is maintained on the WA7BNM Contest Calendar at* **www.contestcalendar.com** *and is extracted for publication in* QST *2 months prior to the month of the contest. ARRL gratefully acknowledges the support of Bruce Horn, WA7BNM, in providing this service.*

Kelly Taylor, VE4XT, ve4xt@mymts.net

2021 ARRL November Sweepstakes — CW

Last year's ARRL November Sweepstakes (CW weekend) was held November 6 – 8, 2021.

ICOM
PRINCIPAL AWARDS SPONSOR

Plaque Sponsors

ARRL is pleased to award a Sweepstakes Plaque to the Overall and Division Leaders in each category, thanks to Icom America, clubs, and individuals who sponsor these awards. For more information on plaque sponsorship or to order a duplicate plaque, contact the ARRL Contest Program at 860-594-0232 or **contests@arrl.org**. Plaques cost $80, which includes all shipping charges.

Winner	Division	Category	Sponsor
K5TR (N5RZ, op)	Overall	Single Operator High Power CW	Trey Garlough, N5KO
K7GK (@W6JZH)	Overall	Single Operator Low Power CW	Radiosport Manitoba — VE4VV Memorial
N2IC	Overall	Single Operator QRP CW	Icom America
KØEU	Overall	Single Operator Unlimited High Power CW	Icom America
N4ZZ	Overall	Single Operator Unlimited Low Power CW	Icom America
W2GD	Overall	Single Operator Unlimited QRP CW	Icom America
NG3R	Overall	Multioperator High Power CW	Icom America
WP3TT	Overall	Multioperator Low Power CW	Icom America
KØHC (WØBH, op)	Overall	School Club CW	Icom America
AA3B	Atlantic	Single Operator High Power CW	Icom America
K3WU	Atlantic	Single Operator Low Power CW	Icom America
K2NV	Atlantic	Single Operator QRP CW	Icom America
K3MM	Atlantic	Single Operator Unlimited High Power CW	Icom America
K3AU (K2YWE, op)	Atlantic	Single Operator Unlimited Low Power CW	Icom America
W2GD	Atlantic	Single Operator Unlimited QRP CW	Icom America
NG3R	Atlantic	Multioperator High Power CW	Icom America
W2UB (K2QO, op)	Atlantic	School Club CW	Icom America
W9RE	Central	Single Operator High Power CW	Society of Midwest Contesters
K9UIY	Central	Single Operator Low Power CW	Society of Midwest Contesters
K9ZO	Central	Single Operator QRP CW	Icom America
K9CT	Central	Single Operator Unlimited High Power CW	Society of Midwest Contesters
NE9U	Central	Single Operator Unlimited Low Power CW	Society of Midwest Contesters
KV3T	Central	Multioperator High Power CW	Icom America
KA9VVQ	Central	Multioperator Low Power CW	Icom America
K9IU (K7JOE, op)	Central	School Club CW	Icom America
N7IV	Dakota	Single Operator High Power CW	Minnesota Wireless Assn. — In memory of Tod Olson, KØTO
NAØN	Dakota	Single Operator Low Power CW	Minnesota Wireless Assn.
KØUU	Dakota	Single Operator QRP CW	Icom America
KTØA	Dakota	Single Operator Unlimited High Power CW	Minnesota Wireless Assn. — In memory of Jim Dokmo, KØFVF
NØAT	Dakota	Single Operator Unlimited Low Power CW	Minnesota Wireless Assn.
NØUR	Dakota	Single Operator Unlimited QRP CW	Icom America
KØHB	Dakota	Multioperator High Power CW	Icom America
KØJE	Dakota	Multioperator Low Power CW	Icom America
N4OGW	Delta	Single Operator High Power CW	Icom America
N5EE	Delta	Single Operator Low Power CW	Icom America
KØEJ	Delta	Single Operator QRP CW	Icom America
W9SN	Delta	Single Operator Unlimited High Power CW	Icom America
N4ZZ	Delta	Single Operator Unlimited Low Power CW	Icom America
N6MA	Delta	Single Operator Unlimited QRP CW	Icom America
K4TCG	Delta	Multioperator High Power CW	Icom America
K5LSU (AD5VC, op)	Delta	School Club CW	Icom America
NA8V	Great Lakes	Single Operator High Power CW	Icom America
W8WTS	Great Lakes	Single Operator Low Power CW	Icom America
N4TY	Great Lakes	Single Operator QRP CW	Icom America
N4QS	Great Lakes	Single Operator Unlimited High Power CW	Icom America
K4FN	Great Lakes	Single Operator Unlimited Low Power CW	Icom America
K8ZT	Great Lakes	Single Operator Unlimited QRP CW	Icom America
K8LX	Great Lakes	Multioperator High Power CW	Icom America
W8EDU	Great Lakes	School Club CW	Icom America
N2NT	Hudson	Single Operator High Power CW	Icom America
W2AAB	Hudson	Single Operator Low Power CW	Icom America
AC2YD	Hudson	Single Operator QRP CW	Icom America
KD2RD	Hudson	Single Operator Unlimited High Power CW	Icom America
K2TW	Hudson	Single Operator Unlimited Low Power CW	Icom America
WA2JQK	Hudson	Multioperator High Power CW	Icom America
NJ1F	Hudson	Multioperator Low Power CW	Icom America
NSØR	Midwest	Single Operator High Power CW	Icom America
NØNI	Midwest	Single Operator Low Power CW	Icom America
NØSSM	Midwest	Single Operator QRP CW	Icom America
NJ8M	Midwest	Single Operator Unlimited High Power CW	Icom America
KØVBU	Midwest	Single Operator Unlimited Low Power CW	Icom America
KKØU	Midwest	Single Operator Unlimited QRP CW	Icom America
ABØS	Midwest	Multioperator High Power CW	Icom America
KØHC (WØBH, op)	Midwest	School Club CW	Icom America
K5ZD	New England	Single Operator High Power CW	Icom America
K1XM	New England	Single Operator Low Power CW	Icom America
N1DID	New England	Single Operator QRP CW	Icom America
W1SJ	New England	Single Operator Unlimited High Power CW	Icom America
K1TR	New England	Single Operator Unlimited Low Power CW	Icom America
W1AW	New England	Multioperator High Power CW	Icom America
W1FM	New England	Multioperator Low Power CW	Icom America
N9RV	Northwestern	Single Operator High Power CW	Icom America
WJ9B	Northwestern	Single Operator Low Power CW	Icom America
W7YAQ	Northwestern	Single Operator QRP CW	Icom America
KA6BIM	Northwestern	Single Operator Unlimited High Power CW	Icom America
K7QA	Northwestern	Single Operator Unlimited Low Power CW	Icom America
NN7SS (K6UFO, op)	Northwestern	Single Operator Unlimited QRP CW	Icom America
N7DX	Northwestern	Multioperator High Power CW	Icom America
WD6T (@N6RO)	Pacific	Single Operator High Power CW	Icom America
K7GK	Pacific	Single Operator Low Power CW	Icom America
W6JTI	Pacific	Single Operator QRP CW	Icom America
W1SRD	Pacific	Single Operator Unlimited High Power CW	Icom America
K6JS	Pacific	Single Operator Unlimited Low Power CW	Icom America
K6OO	Pacific	Single Operator Unlimited QRP CW	Icom America
W6YX	Pacific	Multioperator High Power CW	Icom America
K4ZW	Roanoke	Single Operator High Power CW	Potomac Valley Radio Club
K7SV	Roanoke	Single Operator Low Power CW	Icom America
K4QPL	Roanoke	Single Operator QRP CW	Icom America
W4NF	Roanoke	Single Operator Unlimited High Power CW	Icom America
N3HEE	Roanoke	Single Operator Unlimited Low Power CW	Icom America
N3ZL	Roanoke	Single Operator Unlimited QRP CW	Icom America
W4TG	Roanoke	Multioperator Low Power CW	Icom America
NG7M	Rocky Mountain	Single Operator High Power CW	Icom America
WY7M	Rocky Mountain	Single Operator Low Power CW	Icom America
N2IC	Rocky Mountain	Single Operator QRP CW	Icom America
KØEU	Rocky Mountain	Single Operator Unlimited High Power CW	Icom America
AD1C	Rocky Mountain	Single Operator Unlimited Low Power CW	Icom America
KK5OV	Rocky Mountain	Multioperator Low Power CW	Icom America
NN7CW	Southeastern	Single Operator High Power CW	Icom America
WW4XX (LZ4AX, op)	Southeastern	Single Operator Low Power CW	Icom America
K3TW	Southeastern	Single Operator QRP CW	Icom America
N2NL	Southeastern	Single Operator Unlimited High Power CW	Icom America
N4AO (WC4E, op)	Southeastern	Single Operator Unlimited Low Power CW	Icom America
WB4OMM	Southeastern	Single Operator Unlimited QRP CW	Icom America
K5KG	Southeastern	Multioperator High Power CW	Icom America
WP3TT	Southeastern	Multioperator Low Power CW	Icom America
W4AQL (KN8U, op)	Southeastern	School Club CW	Icom America
ND7K (N6MJ, op @N6WIN)	Southwestern	Single Operator High Power CW	Icom America
KI6RRN	Southwestern	Single Operator Low Power CW	Icom America
N7IR	Southwestern	Single Operator QRP CW	Icom America
N5ZO	Southwestern	Single Operator Unlimited High Power CW	Icom America
K6WSC	Southwestern	Single Operator Unlimited Low Power CW	Icom America
AI6DO	Southwestern	Single Operator Unlimited QRP CW	Icom America
KY7M	Southwestern	Multioperator High Power CW	Icom America
W8TK	Southwestern	Multioperator Low Power CW	Icom America
K7UAZ (KG6T, op)	Southwestern	School Club CW	Icom America
K5TR (N5RZ, op)	West Gulf	Single Operator High Power CW	Icom America
KG5U	West Gulf	Single Operator Low Power CW	Icom America
AA5KD	West Gulf	Single Operator QRP CW	Icom America
W5NE	West Gulf	Single Operator Unlimited High Power CW	Icom America
WA8ZBT	West Gulf	Single Operator Unlimited Low Power CW	Icom America
K5KJ	West Gulf	Single Operator Unlimited QRP CW	Icom America
K5CM	West Gulf	Multioperator High Power CW	Icom America
WD8GTY	West Gulf	Multioperator Low Power CW	Icom America
VE4EA	Canada	Single Operator High Power CW	Icom America
VE5SF	Canada	Single Operator Low Power CW	Icom America
VE3SIF	Canada	Single Operator QRP CW	Icom America
VE7CC	Canada	Single Operator Unlimited High Power CW	Icom America
VE3YT	Canada	Single Operator Unlimited Low Power CW	Icom America
VE3KI	Canada	Single Operator Unlimited QRP CW	Icom America
VE7KW	Canada	Multioperator High Power CW	Icom America

Top Ten

Single Operator, High Power

K5TR (N5RZ, op)	232,680
ND7K (N6MJ, op @N6WIN)	228,312
N9RV	225,262
N4OGW	219,240
W9RE	219,240
K5WA	216,384
N2NT (N2NC, op)	215,712
W7RM (N6TR, op)	213,808
AA3B	213,192
K5PI	213,024

Single Operator, Low Power

K7GK (@W6JZH)	183,120
NA0N (@WØZT)	179,760
WJ9B	179,446
NØNI (AG9A, op)	179,424
KI6RRN	178,616
N7XU (K4XU, op)	169,512
W6AYC	168,264
K7SV	164,304
K1XM	157,248
N5EE	153,716

Single Operator, QRP

N2IC	166,152
KØEJ	109,394
K9ZO	103,840
N7IR	101,188
W6JTI	81,836
K4QPL	76,464
K3TW	69,994
WI9WI	68,222
W7YAQ	65,600
K2NV	49,248

Single Operator Unlimited, High Power

KØEU	232,224
N5ZO	223,272
K9CT	218,232
K3MM	205,632
K6LL	201,432
KD4D	193,536
VE7CC	191,688
W1SRD	190,848
W7RN (W9KKN, op)	187,152
NH7T (@KH6YY)	186,984

Single Operator Unlimited, Low Power

N4ZZ	185,808
NE9U	168,504
N9CO	161,952
K7QA	155,400
K1TR	147,336
NØAT	146,832
N3HEE	145,320
N1QD (@K1KP)	139,440
WT9U	138,264
K4FN	134,568

Single Operator Unlimited, QRP

W2GD	123,328
VE3KI	91,392
NØUR	81,120
KKØU	69,554
N6MA	59,598
K5KJ	52,930
K6OO	45,346
VE6EX	35,280
N3ZL	34,500
WR3R	33,900

Multioperator, Single Transmitter, High Power

NG3R	212,016
W6YX	210,504
KY7M	207,648
ABØS	200,760
K8IA	198,912
K5CM	198,744
N7DX	194,376
NX6T	183,624
K3AJ	171,192
K8LX	162,960

Multioperator, Single Transmitter, Low Power

WP3TT	194,712
W8TK	165,336
KA9VVQ	61,446
W4TG	60,040
W1FM	57,510
KT4XA	55,840
WD0GTY	53,460
W5AFV	47,558
N9MT	41,850
W9ET	38,654

School Club

KØHC	162,624
K9IU	77,274
W9JWC	74,260
K7UAZ	61,560
W2UB	46,576
K5LSU	6,624
W4AQL	360
W8EDU	286

Division Winners

Single Operator, High Power

Atlantic	AA3B	213,192
Central	W9RE	219,240
Dakota	N7IV	138,444
Delta	N4OGW	219,240
Great Lakes	NA8V	126,198
Hudson	N2NT (N2NC, op)	215,712
Midwest	NSØR	157,080
New England	K5ZD	201,026
Northwestern	N9RV	225,262
Pacific	WD6T (@N6RO)	197,374
Roanoke	K4ZW	185,640
Rocky Mountain	NG7M	149,076
Southeastern	NN7CW	205,968
Southwestern	ND7K (N6MJ, op @N6WIN)	228,312
West Gulf	K5TR (N5RZ, op)	232,680
Canada	VE4EA	165,648

Single Operator, Low Power

Atlantic	K3WU	121,032
Central	K9UIY	107,914
Dakota	NA0N (@WØZT)	179,760
Delta	N5EE	153,716
Great Lakes	W8WTS	149,016
Hudson	W2AAB	38,736
Midwest	NØNI (AG9A, op)	179,424
New England	K1XM	157,248
Northwestern	WJ9B	179,446
Pacific	K7GK (@W6JZH)	183,120
Roanoke	K7SV	164,304
Rocky Mountain	WY7M	124,820
Southeastern	WW4XX (LZ4AX, op)	152,388
Southwestern	KI6RRN	178,616
West Gulf	KG5U	114,210
Canada	VE5SF	134,946

Single Operator, QRP

Atlantic	K2NV	49,248
Central	K9ZO	103,840
Dakota	KØUU	4,104
Delta	KØEJ	109,394
Great Lakes	N4TY	14,820
Hudson	AC2YD	37,888
Midwest	NØSSM	35,280
New England	N1DID	28,000
Northwestern	W7YAQ	65,600
Pacific	W6JTI	81,836
Roanoke	K4QPL	76,464
Rocky Mountain	N2IC	166,152
Southeastern	K3TW	69,994
Southwestern	N7IR	101,188
West Gulf	AA5KD	16,226
Canada	VE3SIF	17,284

Single Operator Unlimited, High Power

Atlantic	K3MM	205,632
Central	K9CT	218,232
Dakota	KTØA	171,864
Delta	W9SN	172,200
Great Lakes	N4QS	176,400
Hudson	KD2RD	147,504
Midwest	NJ8M	141,432
New England	W1SJ	182,616
Northwestern	KA6BIM	133,392
Pacific	W1SRD	190,848
Roanoke	W4NF	171,644
Rocky Mountain	KØEU	232,224
Southeastern	N2NL	184,632
Southwestern	N5ZO	223,272
West Gulf	W5NE	154,896
Canada	VE7CC	191,688

Single Operator Unlimited, Low Power

Atlantic	K3AU (K2YWE, op)	96,280
Central	NE9U	168,504
Dakota	NØAT	146,832
Delta	N4ZZ	185,808
Great Lakes	K4FN	134,568
Hudson	K2TW	119,556
Midwest	KØVBU	118,272
New England	K1TR	147,336
Northwestern	K7QA	155,400
Pacific	K6JS	61,620
Roanoke	N3HEE	145,320
Rocky Mountain	AD1C	130,032
Southeastern	N4AO (WC4E, op)	97,170
Southwestern	K6WSC	104,414
West Gulf	WA8ZBT	80,422
Canada	VE3YT	128,856

Single Operator Unlimited, QRP

Atlantic	W2GD	123,328
Dakota	NØUR	81,120
Delta	N6MA	59,598
Great Lakes	K8ZT	10,614
Midwest	KKØU	69,554
Northwestern	NN7SS (K6UFO, op)	3,420
Pacific	K6OO	45,346
Roanoke	N3ZL	34,500
Southeastern	WB4OMM	3,312
Southwestern	AI6DO	24,900
West Gulf	K5KJ	52,930
Canada	VE3KI	91,392

Multioperator, Single Transmitter, High Power

Atlantic	NG3R	212,016
Central	KV3T	104,496
Dakota	KØHB	133,056
Delta	K4TCG	132,048
Great Lakes	K8LX	162,960
Hudson	WA2JQK	30,044
Midwest	ABØS	200,760
New England	W1AW	75,998
Northwestern	N7DX	194,376
Pacific	W6YX	210,504
Southeastern	K5KG	162,120
Southwestern	KY7M	207,648
West Gulf	K5CM	198,744
Canada	VE7KW	162,514

Multioperator, Single Transmitter, Low Power

Central	KA9VVQ	61,446
Dakota	KØJE	3,608
Hudson	NJ1F	23,496
New England	W1FM	57,510
Roanoke	W4TG	60,040
Rocky Mountain	KK5OV	12,614
Southeastern	WP3TT	194,712
Southwestern	W8TK	165,336
West Gulf	WDØGTY	53,460

School Club

Atlantic	W2UB	46,576
Central	K9IU	77,274
Delta	K5LSU	6,624
Great Lakes	W8EDU	286
Midwest	KØHC	162,624
Southeastern	W4AQL	360
Southwestern	K7UAZ	61,560

Steven Linley, WA8Y, logged 691 contacts with 82 multipliers, earning first place in the Single Operator, High Power category for Michigan, and third place in the Great Lakes Division. [Steven Linley, WA8Y, photo]

Full Results Online

You can read the full results of the contest online at **http://contests.arrl.org**. You'll find detailed analysis and more play-by-play, along with the full line scores. Improve your results by studying your log-checking report, too.

The 2022 ARRL November Sweepstakes (CW weekend) will be held November [illegible], 2022.

Rick Rosen, K1DS, rick1ds@hotmail.com

2021 ARRL International EME Contest

Last year, the 2.3 GHz and up weekend of the International EME Contest was held October 23 – 24. The 50 – 1296 MHz weekends took place November 20 – 21 and December 18 – 19.

Multioperator Scores by Category

Call Sign	Score	QSOs	Mults
Multioperator, CW/Phone Only, All Band			
SP6JLW	832,000	128	65
Multioperator, CW/Phone Only, 1.2 GHz			
F6KRK	12,000	12	10
Multioperator, All Mode, All Band			
UA5Y	7,614,000	405	188
NC1I	4,219,200	293	144
K2UYH	4,218,900	287	147
K5QE	2,656,400	229	116
W6YX	1,662,500	175	95
W4ZST	319,600	68	47
OH1LRY	288,600	74	39
LU1CGB	168,000	48	35
K4EME	134,400	48	28
OZ9KY	112,000	40	28
Multioperator, All Mode, 144 MHz			
RX1AS	1,386,900	207	67
SK6EI	377,200	82	46
F6HEO	176,000	55	32
W9VW	112,500	45	25
LU9FVS	400	2	2
CE3SSB	100	1	1
Multioperator, All Mode, 432 MHz			
S51LF	273,000	78	35
Multioperator, All Mode, 1.2 GHz			
SK0CT	660,000	132	50
IQ2DB	606,900	119	51
IK5VLS	504,000	105	48
K0PRT	336,200	82	41
SP3YDE	315,900	81	39
VA7MM	273,600	72	38
K2QM	227,200	71	32
DL0SHF	70,300	37	19
Multioperator, All Mode, 2.3 GHz			
OK1KIR	65,100	31	21
Multioperator, All Mode, 10 GHz			
W3SZ	22,800	19	12

Single Operator Scores by Category

Call Sign	Score	QSOs	Mults
Single Operator, CW/Phone Only, All Band			
G3LTF	561,000	102	55
WA6PY	244,000	61	40
SP3XBO	158,100	51	31
LZ1DP	102,500	41	25
HB9BBD	15,400	14	11
SM6FHZ	13,000	13	10
VE3WY	9,600	12	8
Single Operator, CW/Phone Only, 432 MHz			
DL9KR	31,200	24	13
JA0TJU	1,200	4	3
F6HLC	100	1	1
Single Operator, CW/Phone Only, 1.2 GHz			
DG5CST	696,600	129	54
G4CCH	450,000	100	45
DL7UDA	427,800	93	46
KL6M	373,800	89	42
DL6SH	362,700	93	39
OK1CS	331,500	85	39
DL1SUZ	265,200	78	34
RA3EC	259,200	72	36
OZ4MM	234,600	69	34
SP9VFD	210,800	68	31
DU3T	200,100	69	29
SP6ITF	185,600	64	29
F5KUG	162,400	56	29
JH1KRC	114,400	44	26
IK3COJ	99,000	45	22
LZ2US	99,000	45	22
N4PZ	64,000	32	20
WK9P	53,200	28	19
JF3HUC	48,000	24	20
NO7B	46,800	26	18
IW2FZR	44,800	32	14
DL1AT	33,600	24	14
W2BYP	31,500	21	15
OK2PE	29,900	23	13
DJ3JJ	4,200	7	6
Single Operator, All Mode, All Band			
UA3PTW	5,584,000	349	160
DL7APV	4,012,000	295	136
YL2GD	2,363,400	202	117
SM4GGC	1,479,000	170	87
LZ1DX	1,170,000	150	78
PA2CHR	931,000	133	70
PA3DZL	897,600	132	68
KD2LGX	716,800	112	64
K3WM	504,400	97	52
ES3RF	409,200	93	44
F2CT	348,300	81	43
N0AKC	321,200	73	44
W2LPL	309,600	72	43
WA3RGQ	299,200	68	44
N1AV	292,500	65	45
W1PV	237,800	58	41
OK2ULQ	234,500	67	35
DL4DTU	234,000	60	39
US7GY	172,800	54	32
JJ3JHP	142,800	51	28
UA3TCF	139,200	48	29
4Z5CP	68,200	31	22
KN0WS	64,400	28	23
YO5TP	62,000	31	20
W5LUA	57,200	26	22
WQ5S	54,600	26	21
W1FKF	48,600	27	18
UR5LX	35,200	22	16
G4BRK	1,600	4	4
HI8DL	900	3	3
JG2TSL	900	3	3
Single Operator, All Mode, 50 MHz			
OH2BC	19,200	16	12
YB2MDU	2,500	5	5
Single Operator, All Mode, 144 MHz			
S51ZO	930,000	150	62
IW4ARD	731,600	124	59
WA1NPZ	530,000	100	53
OK1DIX	485,000	97	50
WB9UWA	485,000	97	50
K1DG	427,700	91	47
G8RWG	396,000	88	45
SM2BYC	259,200	72	36
UT9UR	183,600	54	34
9H1TX	183,000	61	30
JA1DYB	154,000	55	28
UA9YJM	153,900	57	27
KA1W	153,000	51	30
JP3EXR	141,000	47	30
HG5BMU	127,400	49	26
W6TCP	112,000	40	28
7K3LGC	109,200	42	26
AG4W	108,000	40	27
HS0ZIL	105,000	42	25
I2FAK	100,800	36	28
UA1OEJ	91,000	35	26
K7ULS	72,600	33	22
K8DIO	71,400	34	21
KG6NK	70,400	32	22
SM5CUI	67,200	28	24
W7GJ	60,900	29	21
9Y4D	45,000	25	18
BA4SI	44,800	28	16
JH0WJF	43,200	27	16
TA2NC	42,000	28	15
N9EP	33,000	22	15
WB6RJH	23,800	17	14
EA7KI	20,400	17	12
LU5BOJ	20,400	17	12
KC2HFQ	18,000	15	12
N7ZO	15,400	14	11
LX/PE1ITR	10,400	13	8
R7LP	6,000	10	6
CX2SC	5,600	8	7
UA6BAC	4,800	8	6
SP8OOU	3,500	7	5
UC8Y	3,500	7	5
DL8JJ	2,500	5	5
VE1KG	2,000	5	4
YU1MS	1,600	4	4
YO6XK	1,200	4	3
KK4MA	900	3	3
DF7TS	600	3	2
UA9CCL	600	3	2
OH1MN	400	2	2
UR3VKC	400	2	2
EA7E	100	1	1
N2AMC	100	1	1
ON7EQ	100	1	1
W8TN	100	1	1
Single Operator, All Mode, 222 MHz			
WA4NJP	2,500	5	5
W5ZN	1,200	4	3
Single Operator, All Mode, 432 MHz			
PA5Y	705,600	126	56
S56P	387,000	86	45
7M2PDT	217,600	64	34
VK2CMP	117,000	45	26
VK4EME	112,700	49	23
RD3FD	96,600	42	23
OK1TEH	66,000	33	20
KU4XO	65,100	31	21
N1QG	39,100	23	17
UB4UAA	38,400	24	16
DF7KB	36,800	23	16
DL7URH	36,400	26	14
YO8RHI	33,000	22	15
DL1VPL	26,000	20	13
JH7BAY	23,800	17	14
F1NZC	16,200	18	9
F4VTP	14,300	13	11
PE1ITR	8,800	11	8
RW0LDF	8,100	9	9
N7GP	4,900	7	7
JR0WFY	4,200	7	6
YO2NAA	4,000	8	5
KB0Z	2,500	5	5
TI1K	2,500	5	5
N5NHJ	2,000	5	4
N6WS	1,600	4	4
K7ATN	900	3	3
MX0CNS	600	3	2
AK4WQ	400	2	2
K3GNC	400	2	2
IK2RHE	200	2	1
UR7IMM	100	1	1
Single Operator, All Mode, 1.2 GHz			
OK2DL	1,075,200	168	64
DF3RU	803,700	141	57
PA3FXB	612,000	120	51
IK2DDR	575,000	115	50
SM5DGX	571,200	112	51
OK1KKD	535,000	107	50
RA4HL	488,800	104	47
OM4XA	474,700	101	47
N5BF	423,200	92	46
KA1GT	378,000	90	42
SP5GDM	369,800	86	43
YO2LAM	344,400	82	42
GM0PJD	328,000	80	41
K7CA	323,900	79	41
KB2SA	276,900	71	39
OK1DFC	250,800	76	33
PE1LWT	200,600	59	34
DK5AI	186,000	60	31
RX6AIA	186,000	60	31
W5AFY	183,600	54	34
AA6I	171,600	52	33
RD4D	171,000	57	30
RN6MA	135,000	50	27
CE3VRT	121,500	45	27
HS0ZOP	119,600	46	26
FG8OJ	110,400	46	24
DK1KW	105,600	44	24
VE4SA	104,000	40	26
W5GLD	96,000	40	24
W3CJK	87,500	35	25
KB7Q	70,400	32	22
FR5DN	66,500	35	19
JA4LJB	61,200	36	17
OK1IL	49,400	26	19
AE6GD	44,800	28	16
W3HMS	40,500	27	15
OK1USW	39,200	28	14
I0NAA	37,500	25	15
RA9FLW	36,400	26	14
K7/VE4MA	30,400	19	16
SM6CKU	28,800	24	12
NT6V	10,800	12	9
OH3DP	9,600	12	8
JH3AZC	9,100	13	7
PA0TBR	9,100	13	7
N2END	9,000	10	9
K1DS	3,600	6	6
UA1CCU	1,600	4	4
Single Operator, All Mode, 2.3 GHz			
OK1CA	30,800	22	14
Single Operator, All Mode, 10 GHz			
OK2AQ	46,800	26	18
G4RFR	23,800	17	14

Full Results Online

You can read the full results of the contest online at **http://contests.arrl.org**. You'll find detailed analysis and more play-by-play, along with the full line scores. Improve your results by studying your log-checking report, too.

Total Reported QSOs by Mode

Digital	9,731
CW/Phone	3,066
Total	12,797

Total Reported QSOs by Band

50 MHz	30	3.4 GHz	4
144 MHz	3,892	5.7 GHz	78
222 MHz	24	10 GHz	223
432 MHz	1,784	24 GHz	0
1.2 GHz	6,576	Total	12,797
2.3 GHz	186		

The 2022 International EME Contest weekends are scheduled for September 17 – 18 (2.3 GHz and up weekend), as well as October 15 – 16 and November 12 – 13 (50 – 1296 MHz weekends).

The June 2022 Kids Day

1800 UTC – 2359 UTC Saturday, June 18, 2022

The third Saturday in June is the time to encourage youngsters to get on the air and share in the excitement and fun that amateur radio can provide!

Sponsored by the Boring (Oregon) Amateur Radio Club, the Kids Day on-air event has a simple exchange suitable for a younger operator: first name, age, location, and favorite color. After that, the contact can be as long or short as each participant likes.

Kids Day is the perfect opportunity for you or your club to open your shack doors and invite kids over to discover what amateur radio is all about.

Complete rules and downloadable certificates of participation can be found at www.arrl.org/kids-day

Nine-year-old Liam Perrigoue participated in the June 2021 ARRL Kids Day with his father Joe, K7KCE. It was Liam's first time on the air, and he made several contacts during the event. [Joe Perrigoue, K7KCE, photo]

The 2022 ARRL June VHF Contest

1800 UTC Saturday, June 11 – 0259 UTC Monday, June 13

The June VHF Contest is right around the corner! The late-spring weather brings enhanced tropospheric ducting and meteor scatter. Plus, it's the peak of sporadic-E season. Take advantage of these propagation enhancements and have some fun on the VHF and UHF bands. With several different categories to participate in, there's something to match your favorite style of operating.

Brian Betz, W7JET, participated in the 2021 ARRL June VHF Contest from Mount Ord in Arizona, located in grid square DM43. With 108 contacts and 37 multipliers, he took home first place in the Single Operator, Portable category for the Southwestern Division. [Brian Betz, W7JET, photo]

Here are some things to remember for this contest:

- The exchange is simple: Just the Maidenhead grid square you're operating from. For more information on grid squares, visit **www.arrl.org/grid-squares**.
- All authorized modes on 50 MHz bands and higher are permitted to be used in the contest.
- Assistance is permitted in all ARRL VHF contests — you can make announcements or chat with others about your contest activity (as long as the contact is completed over the air).
- Log submissions: Upload your Cabrillo log file to the contest web app at **http://contest-log-submission.arrl.org**. Paper logs can be mailed to ARRL — June VHF Contest, 225 Main St., Newington, CT 06111.
- Ten-day deadline: all logs must be uploaded or postmarked no later than 0259 UTC, June 23.
- Share your photos and VHF contest stories to the ARRL Contest Soapbox page at **http://contests.arrl.org/contestsoapbox.php**.

Complete rules can be found at www.arrl.org/june-vhf

2022 FIELD DAY

One of the most popular amateur radio on-air events returns June 25 – 26, 2022. It will run from 1800 UTC Saturday, June 25 to 2059 UTC Sunday, June 26.

Bands and Modes: Participants may only operate on the 160-, 80-, 40-, 20-, 15-, and 10-meter HF bands, and may use all bands 50 MHz and above using phone, CW, and/or digital modes.

Setup: Class A and B stations that wish to operate for only 24 hours may begin their setup at 0000 UTC on the Friday (Thursday afternoon or evening local time) preceding the ARRL Field Day period. Cumulative setup time for those stations may not exceed a total of 24 hours. Class A and B stations that wish to operate the full 27-hour Field Day period may not begin setup until 1800 UTC on Saturday.

Reporting Your Score: All entries must be received at ARRL HQ no later than Tuesday, July 26, 2022. Participants are strongly encouraged to use the online ARRL Field Day score reporting system at **www.field-day.arrl.org**. Online entrants will receive an email confirmation that their entry was accepted, as well as 50 bonus points for submitting their score electronically.

New Rules for 2022: All entrants, regardless of entry category, are now limited to a maximum of 100 W peak envelope power (PEP). The rules waivers that have been in effect for the previous 2 years have also become permanent: Class D stations can work other Class D stations for points, and all entrants, regardless of their entry category, can contribute their scores to that of their club's aggregate score, which will be published in *QST*.

The rules for media publicity bonus points have been modified for 2022. In order to earn the 100 bonus points, participants must show proof that media covered their event, rather than participants only attempting to get coverage.

Let everyone know where you'll be operating for Field Day by using the Field Day Station Locator at **www.arrl.org/field-day-locator**. It can be used to find a nearby Field Day site, or an operation to join if you're traveling out of town.

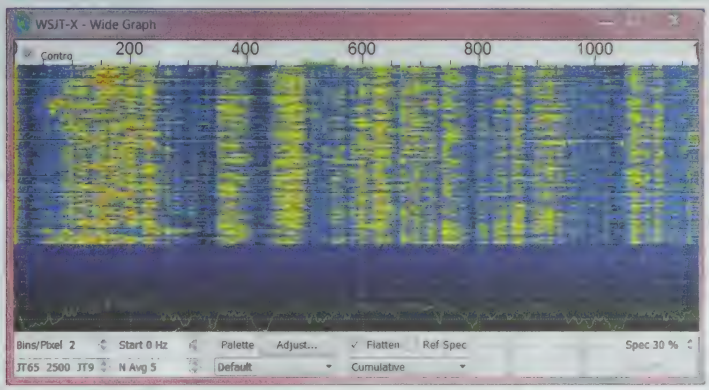
Groups and individuals can share their plans and tips for a successful Field Day on the ARRL Field Day Facebook page, at **www.facebook.com/groups/arrlfd**. Be sure to use the hashtag **#ARRLFD**.

Participants should download and review the material found in the 2022 Field Day packet (including information about available bonus points), at **www.arrl.org/field-day**. Email any questions to **fdinfo@arrl.org**.

During the 2021 ARRL Field Day, Paul Nemeth, W4DUI, set up the GOTA (Get On The Air) station for coaching at the North Georgia Amateur Radio Club, W4QQ, Field Day site. [N. Renee Conaway, KK4LOJ, photo]

ARRL's New International Digital Contest

1800 UTC Saturday, June 4 – 2359 UTC Sunday, June 5, 2022



Get ready for a weekend of nothing but digital modes in ARRL's new International Digital Contest, where all digital modes (except RTTY) are allowed.

The inaugural running of the ARRL International Digital Contest occurs during the first weekend of June. With the exception of RTTY, all digital modes that can support the contest exchange are permitted. Going forward, ARRL's RTTY Roundup will become a RTTY-only event, and will continue to take place during the first full weekend in January.

The International Digital Contest is a digital competition on the 160-, 80-, 20-, 15-, 10-, and 6-meter bands, with single-operator and multioperator options for the single transmitter category. Single-operator categories include Single Operator, One Radio (SO1R) and Single Operator, Two Radio (SO2R). The single-operator category overlays include "All Enclosed Antennas" (indoor antennas), "Limited Time" (a maximum of 8 operating hours), and "All Enclosed Antennas and Limited Time."

The contest exchange is the station's four-character grid square. For more information about grid squares, visit **www.arrl.org/grid-squares**.

Participants earn one point per contact, plus one point for every 500-kilometer distance between stations. The total score is the sum of all the contact points. See **http://arrl.org/arrl-digital-contest** for scoring examples.

Stations may work each other once per band, regardless of digital mode (excluding RTTY).

Power categories are QRP (5 W PEP transmitter output or less) and low power (100 W PEP transmitter output). There is no high-power category for this event.

Participants may contribute their scores to the ARRL Affiliated Club Competition, as well as form a team with fellow participants. Teams must consist of two to five single-operator stations that are operating within a 175-mile radius, and whose individual scores can be combined to produce a team score. Teams must be registered at **http://contests.arrl.org/teamreg.php?eid=31** prior to the start of the contest.

Logs must be submitted by 2359 UTC on June 12, 2022, via the contest web app at **http://contest-log-submission.arrl.org**. Only Cabrillo-formatted electronic logs will be accepted for this event.

Visit **http://arrl.org/arrl-digital-contest** for full rules and details.

Bernie McClenny, W3UR, w3ur@arrl.org

How's DX?

A Mini-DXpedition to Togo, Africa

Daniel Eberli, HB9EHD, is often traveling the world for his career as a doctor, and likes to try to combine ham radio with his travels whenever he can. In this month's column, Daniel talks about his most recent adventure to Togo, Africa, how he was able to turn it into a mini-DXpedition, and the highs and lows of the operation.

In 2021, myself and another doctor traveled to Togo, Africa, to teach surgical techniques to fellow doctors in a small hospital located in Kara, which is a city in northern Togo. I thought it might be a great opportunity to bring some ham radio gear along and attempt a mini-DXpedition while I was there, and my son came along as well.

Challenges upon Arrival

In preparation for the trip, we got our visas stamped, received negative COVID test results, and were granted the call sign 5VDE by the responsible authority of Togo.

We had a great feeling about our trip as we boarded the airplane with about 70 pounds of radio equipment. However, once we landed, it seemed like everything that could go wrong, did. First, a spelling error on my visa made it invalid. Then, the COVID test I took upon arrival in Togo resulted in a false positive, putting me in quarantine until I could re-test. And lastly, it turned out that 5VDE couldn't be used for our FT8 operations because it's a non-standard call sign.

Thankfully, I was able to contact my connections at the ART&P (Autorité de Réglementation des secteurs de Postes et de Télécommunications) in Togo (I contacted them so many times prior to the trip that some friendly employees gave me their cell phone numbers). They understood the situation and offered me the additional call sign, 5V7DE, for use on FT8 (I was able to operate SSB over satellite with 5VDE). My second COVID test was negative, and my visa problem was solved days later after a 5-hour drive to the immigration office.

I set up my end-fed half-wave antenna on the roof of the hotel with a fishing rod to get the end off the ground, and I was able to successfully operate on 20 and 40 meters.

Antenna Setup

Setting up DXpedition antennas is nothing like testing a new antenna in your back yard. In Africa, the heat was unbearable — the temperature got up to 115 °F (46 °C). I had to travel light, so I used an end-fed half-wave (EFHW) for 20 and 40 meters, and a small satellite dish for the QO-100 geostationary satellite.

After throwing the antenna wire over a palm tree and using a fishing rod to get the end off the ground, I switched on my Yaesu FT-991A transceiver. The interference was S9 + 10 dB, and I couldn't hear any FT8 activity. My disappointment was even greater when the signal-to-noise ratio of my portable satellite dish was so limited, that I could only see (not decipher) the signals in the software defined radio (SDR) console. At home, the modified ADALM-PLUTO (an SDR active learning module) did a great job for QO-100. However, during January and February, there are usually heavy Sahara winds along the Ivory Coast (Côte d'Ivoire) that carry sand particles in the air, so that might have been blocking some of my signal.

We drove to the street market in Lomé for electronic goods, and I bought a bright blue secondhand satellite antenna that was larger than my current one.

During my first attempt at making contacts, my Yaesu FT-991A transceiver read an interference of S9 + 10 dB, and I couldn't hear any FT8 activity.

We were able to pack all of our equipment into one box, weighing just over 70 pounds. It included a Yaesu FT-991A transceiver, laptop, MFJ switching power supply, end-fed half-wave antenna with a 49:1 balun, an ADALM-PLUTO SDR learning module, and a small camping satellite dish.

Operation Results

Back at the hotel I replaced my camping satellite dish with the larger one, used duct tape to fix the POTY low-noise block (LNB) antenna to the arm, and was rewarded with a 30 dB signal on the lower beacon! In the midst of the heat, I attempted to make my first contact below the middle beacon and got the first pileup over the satellite. It was hard work, but I managed to make 100 contacts that evening.

Then, with the setting sun, the interference on 20 and 40 meters was suddenly lower, indicating that the interference might be caused by solar panel chargers. FT8 was fun! Using my EFHW and 90 W, I was able to contact stations on all continents except for Oceania. I'm thankful that many of the hams I contacted had antenna farms, which helped with confirming the contacts.

Over the next few days, I worked in the hospital during the day. During my spare time, I was ready for operations on the satellite and FT8. Split operation on the satellite was faster, but more demanding. Sometimes I would get up very early in the morning to catch the eastern hemisphere on 40 meters.

Setting the precise time for FT8 operation was challenging. Because I had no internet connection for *NetTime* (free Windows software that syncs your computer clock via the internet), my FT8 signals were sometimes off by 2 seconds. I tried to use my wristwatch to adjust the time error, but I'll have to remember to bring an attached GPS the next time.

A highlight of our trip was a ride into the jungle in Kpalime, located in the eastern part of Togo. I took the gear with me, and we found a small village store where I was able to get a dc wall wart for my radio. It's truly amazing that we were able to make some contacts over QO-100 through the large trees!

Reflections

The environment in Togo is unforgiving, and the temperatures are often over 104 °F (40 °C). The big 49:1 unun impedance transformer of the EFHW got really hot, and I noticed a drop of reported signal strength in FT8, as well as changes in the automatic level control (ALC) circuit. Also, the 2.4 GHz amplifier wasn't able to passively cool, and I had to stop communicating after some time to allow it to cool down. The constant interference of poor electric wiring and overheating problems limited some of my activities. I later found out that many operators tried to contact me without luck. *WSJT* did a great job, but wasn't able to pick out some faint signals in the interference. We still managed to get over 750 contacts logged in the short time we were in Togo. I know many of you made a significant effort to contact me, and I thank you all for your hard work.

I hope this story motivates other hams to make a mini-DXpedition out of your next business trip or vacation. Throw some gear in your bag, apply for a local call sign, and make other hams happy at home!

All photos by the author.

Jon Jones, NØJK, n0jk@arrl.org

Getting on the 222 MHz Band

With the recent flurry of 222 MHz Worked All States (WAS) applicants, interest in the band has surged, but many operators are having difficulty getting on it. Here are some tips.

Obstacles

Getting on the 222 MHz band is not as straightforward as the other lower VHF and UHF bands. Because 222 MHz is not a worldwide allocation, radio manufacturers may feel there is not the demand for a radio including the band.

There were several 220 and 222 MHz radios made. The only multimode rigs ever made with coverage on 220 and 222 MHz were the Yaesu FT-736 (needed the required module) and the standalone single-band Icom IC-375 and IC-375H. The IC-375 is so rare that, when it comes up on eBay, it sells for around $2,500.

Using a Transverter

The most common way to get on 222 MHz is to use a transverter, a device that converts one band to another (in this case most commonly 10 meters), so the capabilities of your HF radio can be used on 222 MHz. The downside is the transverter has to be appropriately cabled and interfaced with your HF radio. It's not hard, but it does require some care. You don't want to transmit into the receive port on your transverter accidentally, or you will ruin it.

Buying a Transverter

One of the transverter vendors, Down East Microwave (**www.downeastmicrowave.com**), also sells amplifiers and other accessories.

A popular line of low-cost 222 MHz transverters comes from Ukraine. They had some issues with gate bias, but when properly adjusted, the units perform adequately. These transverters could usually be purchased from the Transverter Store; however, they are not taking new orders right now. Used transverters are available on eBay and other places.

Microwave Modules made 220 and 222 MHz transverters. They are 1980s-era technology, but they still perform well and can be found used. I had one that used a 50 MHz intermediate frequency (IF) rather than 28 MHz. Thus, it could be used with a single-band 6-meter radio on 222 MHz.

Amplifiers

Most transverters put out 10 – 25 W. This is enough to work local and tropospheric contacts, but for meteor scatter, aurora, and other propagation modes, more power helps.

The Mirage C-3012 amplifier puts out about 100 W. It is not currently being manufactured, but is sometimes available on eBay or at hamfests. TE Systems (**www.tesystems.com**) has a number of amplifiers for sale. The standard model puts out 139 W and retails for around $500. Jim Wilson, K5ND, uses an old RF Concepts amplifier with 30 W input and 120 W output. Jim Klitzing, W6PQL, offers kits for a 1 kW amplifier at **www.w6pql.com/1kw_222mhz_ldmos_amplifier.htm**.

Another option is the AM-6155, which Ken Harker, WM5R, called "the best bang for your buck." These are converted FAA surplus amplifiers. The FAA used the AM-6155 in the 1980s with ground-to-air transmitters. They were designed to cover 225 – 400 MHz at 50 W AM continuous output. With only a few hours of work, and almost no extra parts, they can be converted to 222 MHz. They are capable of over 400 W output on 222 MHz SSB, CW, FT8, and MSK144 at amateur radio duty cycles. This amplifier uses either an Eimac 8930 or an Amperex DX-393 tetrode tube. They can also be found used.

The AM-6155 has enough power to make EME (Earth-moon-Earth) contacts with good antennas and favorable conditions. It is probably too large and heavy (over 70 pounds) for routine portable use and requires ac power, but I had one that operated portable flawlessly during a 1990s Perseid meteor shower grid expedition.

Antennas

A number of vendors, including M^2, DX Engineering, and Directive Systems, offer antennas. The Quagi is a homebrew antenna that is inexpensive and easy to build. The design will be 50 years old, but it is still effective. I use Quagis on 222 and 432 MHz. For more information on the Quagi, check out Wayne Overbeck's, N6NB, overview at **www.overbeck.com/quagi.htm**.

Grid Expedition to CN93

Barry Hansen, K7BWH, operated portable from Glass Butte, Oregon (CN93) on February 11 – 14 on 6 meters (see Figures 1 and 2). Barry's goal was to help Jim Klingler, AAØMZ, in EM29, complete a contact for the last grid he needed for the Fred Fish Memorial Award (FFMA), but unfortunately, they were not able to make a contact. Barry ran a KW amplifier and used the 6M5 M2 Yagi. Two Honda EU2000i generators provided power. There were no sporadic-E openings, so all 14 of his contacts were made via meteor scatter. Barry's farthest contact was with WQØP (EM19) on MSK144 at 2,044 kilometers. He tried EME with Tim Blank, NØTB, who copied Barry. For more details on Barry's trip, visit **www.coilgun.info/travel/2022-02-cn93.htm**.

Figure 1 — Barry Hansen's, K7BWH, portable setup for his grid expedition to Glass Butte, Oregon. [Barry Hansen, K7BWH, photo]

Figure 2 — Barry's car packed for the trip with all his radio gear. [Barry Hansen, K7BWH, photo]

On the Bands

50 MHz. Rafa Ortiz Garza, XE2OR (DL98), worked ZL1SG (RF64) on February 5 via a sporadic-E link to trans-equatorial propagation (TEP) across the geomagnetic equator. Ron Todd, K3FR (FM18), noted that there was E_S to W4 on February 9 and 10.

On February 11, 12, and 13, Dan Street, K1TO (EL87), had strong afternoon TEP openings to South America (see Figure 3). LU9AEA peaked at +34 dB on FT8. On February 15, I, NØJK (EM28), had a short sporadic-E opening to W4IMD (EM84) at 0140 UTC on FT8.

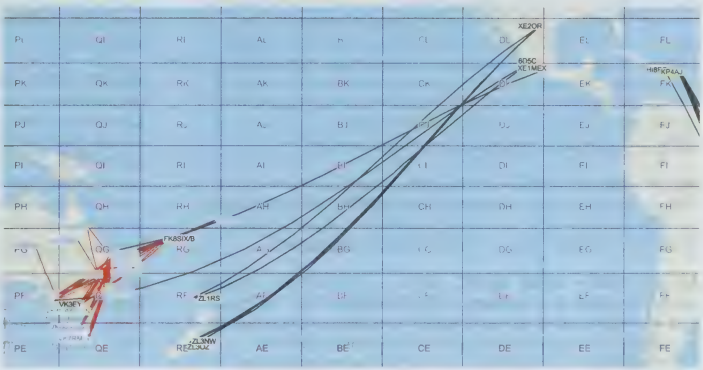


Figure 3 — The DX map shows the E_S link where the paths cross from Mexico to the South Pacific. [**www.dxmaps.com**]

Here and There

Some readers sent inquiries about Maidenhead *grid squares*, which are useful for showing the location of stations on the VHF/UHF and microwave bands. People collect them for awards like the VHF/UHF Century Club (VUCC) and FFMA. Grid square maps are available from ARRL at **www.arrl.org/grid-squares**. If you want to find out what your grid square is, or use a more interactive map, visit **https://www.levinecentral.com/ham/grid_square.php**.

Larry Lambert, NØLL, is planning to operate portable from rare grid square EN20 during the Lyrid meteor shower on April 21 – 23.

On March 7, 2022, a very rare "long path" F2-TEP opening occurred on 50 MHz between New Zealand and the Canary Islands. EA8AQV (IL28) worked ZL1RS and ZL1SG on FT8 at 2134 UTC. The path was over 18,000 kilometers going across South America! This is the first "long-path" F-layer 6-meter opening of Solar Cycle 25. The last long-path 6-meter openings were reported in 2014. More next month!

Special Event Stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Through Dec. 31, 0000Z – 2359Z, GB1900HA and **GB1900HW**, South Shields and Hexham, England. Hadrian's Wall Partnership. **Hadrian's Wall 1900 Festival**. 14.200 7.150 145.500 21.300. QSL. LoTW. *These two special event stations will run throughout 2022 to commemorate 1900 years since the building of Hadrian's Wall.* **www.qrz.com/db/gb1900ha** and **www.qrz.com/db/gb1900hw**

Apr. 15 – Apr. 18, 1400Z – 2359Z, N4D, Mesa, AZ. Superstition Amateur Radio Club, Inc. **80th Anniversary of the Doolittle Raid**. 3.893 7.225 14.330 21.337. QSL. SES N4D, c/o Superstition ARC, P.O. Box 21522, Mesa, AZ 85277-1522. **https://www.superstitionarc.org**

Apr. 18, 1400Z – 2000Z, W2NPT, Fair Lawn, NJ. Fair Lawn Amateur Radio Club. **World Amateur Radio Day**. 7.035 7.250 14.035 14.250. QSL. Fair Lawn Amateur Radio Club, 10-10 20th St., Fair Lawn, NJ 07410. **fairlawnarc.org**

Apr. 18 – Apr. 19, 1500Z – 0030Z, W7W, Ogden, UT. Nevada Amateur Radio Repeaters, Inc., and World Radio Network/World Friendship Net. **World Amateur Radio Day**. 3.920 7.074 14.074 28.400. QSL. Thomas Harrington, 636 W. 24th St., Ogden, UT 84401. **www.wrn-wfn.com** and **narrivoip.com**

Apr. 18 – Apr. 19, 1700Z – 0030Z, WØW, Las Vegas, NV. NARRI *World* EchoLink Conference VoIP. **World Amateur Radio Day**. 146.520 441.500. Certificate. Thomas Harrington, 636 W. 24th St., Ogden, UT 84401. *Check websites for information on the EchoLink System EchoLink Conference *World* on cell phone app and PC or #479886 IRLP 9251 or AllStarLink via WV8CW #43609 QSL.* **www.wrn-wfn.com**, **www.narivoip.com**, and **www.qrz.com/db/w0w**

Apr. 19 – Apr. 20, 0000Z – 2359Z, K6V, Baker, CA. West Valley Amateur Radio Club. **Baker to Vegas LAPD Challenge Race**. 147.465 223.440 445.510. Certificate. West Valley ARC, 5403 N. Annie Ct., Litchfield Park, AZ 85340. **bakervegas.net**

Apr. 23, 1500Z – 1900Z, NE1PL, Fall River, MA. USNR. **Remembering the 80th Anniversary of the Doolittle Raid**. 14.259; 20 and 40 meters; other bands possible as equipment and operators allow. Phone and digital. QSL. Rick Emord, KB1TEE, 135 Wareham St., Middleboro, MA 02344. **www.ne1pl.org**

Apr. 29 – May 1, 1900Z – 1900Z, WØZSW, Minneapolis, MN. Handiham Radio Club. **Handiham 55th Anniversary Special Event**. 7.040 14.265. QSL. Handiham Program, 3915 Golden Valley Rd., Mail Route 78446, Minneapolis, MN 55422. **handiham.net**

Apr. 30 – May 1, 1400Z – 2020Z, N3P, New Kensington, PA. WQ3Q. **Hams for PanCAN**. 3.960. 7.172. Certificate & QSL. Richard Ryba/PanCAN, 2777 Leechburg Rd., New Kensington, PA 15068. **https://secure.pancan.org/site/TR/PurpleStride/PurpleStride?px=3163046&pg=personal&fr_id=2357** or **rybar1949@gmail.com**

Apr. 30 – May 1, 1700Z – 1700Z, N1D, Athens, GA. Athens Radio Club. **UGA Sanford Stadium Special Event**. 3.930 7.230 14.330 28.430. QSL. Athens Radio Club, P.O. Box 782, Athens, GA 30603-0782. **www.athensradioclub.org**

May 7, 1300Z – 2109Z, W4LX, Fort Myers, FL. Fort Myers Amateur Radio Club. **Celebrating National Train Day**. CW 7.040 14.040; PSK31 14.070; SSB 7.260 14.260. Certificate & QSL. Fort Myers Amateur Radio Club, P.O. Box 61183, Fort Myers, FL 33906. *From the Railroad Museum of South Florida.* **www.fmarc.net**

May 7 – May 8, 1300Z – 0100Z, N4B, Moulton, AL. Bankhead Amateur Radio Club, Inc. **40th Anniversary Celebration**. 7.150 14.200 SSB. QSL. Moulton ARC, N4IDX, 215 County Road 599, Moulton, AL 35650. **www.n4idx.com**

May 7 – May 10, 1500Z – 2300Z, W7G, Corinne, UT. Ogden Amateur Radio Club. **Golden Spike Special Event Station**. 7.040 7.235 14.040 14.255. QSL. Ogden Amateur Radio Club, P.O. Box 3353, Ogden, UT 84409. **www.w7g.org**

May 14, 1200Z – 2300Z, NF4GA, Roswell, GA. North Fulton Amateur Radio League. **45th Anniversary**. SSB, CW, and digital on 40 and 20 meters; 7.260 14.260. QSL. North Fulton Amateur Radio League, P.O. Box 1741, Roswell, GA 30077. *Operating from West Island GA 027L.* **https://nfarl.org**

May 14, 1300Z – 1900Z, W1M, Russell, MA. Western Mass Council, Scouts BSA. **WHOA Weekend, Scouts BSA**. 7.190 10.115 14.060 14.290. QSL. Tom Barker, WA1HRH, 329 Faraway Rd., Whitefield, NH 03598. *Paper logging. QSL via SASE and eQSL.*

May 14, 1300Z – 2200Z, Armed Forces stations, Salado, TX. Department of Defense Armed Forces. **Armed Forces Day Crossband Test**. USB 5330.5 14438.5 14383.5. QSL. Armed Forces Day, 13164 FM 2484, Salado, TX 76571. *Military stations will transmit on DOD channels and announce the amateur frequency they are monitoring. A complete list of participating stations, modes, channels, and times will be available after April 1 at* **www.dodmars.org**. **https://www.dodmars.org/mars-comex-information-website/armed-forces-day**

May 14, 1400Z – 2000Z, K4RC, Williamsburg, VA. Williamsburg Area Amateur Radio Club. **Jamestown Landing Day Event**. 7.265 14.265. Certificate & QSL. QSL Manager, K4RC, P.O. Box 1470, Williamsburg, VA 23187. **info@k4rc.net** or **k4rc.net**

May 14, 1400Z – 2200Z, KØM, Inver Grove Heights, MN. South East Metro Amateur Radio Club. **Celebrating the Anniversary of Minnesota Statehood**. 7.035 7.250 14.250 18.100. Certificate (downloadable from website one month after event). **www.semarc.org**

May 14, 1500Z – 2200Z, NØF, Anoka, MN. Anoka County Radio Club. **Minnesota Fishing Opener at Ham Lake Park**. 7.250 14.255. QSL. Anoka County Radio Club, P.O. Box 982, Anoka, MN 55303. **www.anokaradio.org**

May 14, 1600Z – 2300Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Battle of Coral Sea**. 7.250 14.320 14.070 (PSK31); D-STAR (Papa Sys Rept). QSL. USS *Midway* Museum Ship COMEDTRA, 910 N. Harbor Dr., San Diego, CA 92101. **www.qrz.com/db/ni6iw**

May 14 – May 15, 1300Z – 2300Z, WW1USA, Kansas City, MO. World War I Museum and Memorial. **103rd Anniversary of Peace Conference**. 7.030 7.250 14.030 14.250. Certificate & QSL. Charles Van Way, NØCVW, 2 Memorial Dr., Kansas City, MO 64108 for QSL; certificate request to **ww1usa@theworldwar.org**. **www.theworldwar.org/amateurradio**

May 15 – May 17, 0000Z – 2300Z, W4B, Crossville, TN. FMCA-ARC. **FMCA-ARC Spring Rally**. 7.240 7.330 14.240 14.330. QSL. Dennis Tuchalski, 5854 Moro Rd., Moro, IL 62067. *Possible POTA activation; we will spot on DX reflector*. **https://fmcaarc.com**

May 15 – May 21, 0000Z – 2359Z, K3FBI/Ø – 9, Quantico, VA. FBI Amateur Radio Association. **National Police Week — Honor Our Fallen Heroes**. 14.275; all bands, all modes. Certificate. Downloadable certificate only, see website for details. *Multiple club members operating from around the country*. **www.qrz.com/db/k3fbi**

May 15 – May 21, 0000Z – 2359Z, W1N, Winsted, CT. Wireless Operators of Winsted. **Winchester Connecticut 250th Anniversary**. 3.950 7.240 14.270. QSL. Dana Borgman, 72 Wetmore Ave., Winsted, CT 06098. **wb1dju@arrl.net**

May 15 – May 27, 0001Z – 2359Z, K4D, Carribelle, FL. K5TEN. **Dog Island IOTA DXpedition**. SSB 7.185 14.260 21.285 28.310; CW 7.027.5 7.110 10.110 14.027.5 21.027.5 28.010; 6-meter operation for sporadic E. QSL*. Bruce Brady, 208 Mount Tabor Rd., Hot Springs National Park, AR 71913. *Rare NA-085 IOTA island and VHF/UHF Grid Square EL79*. **k5ten@aol.com**

May 16 – May 31, 0000Z – 0000Z, K1A, Cleburne, TX. Club KC5NX. **Memorial Day 2022**. 7.235 7.240 14.045 14.255. QSL. Club KC5NX, 9200 Summit Ct. W., Cleburne, TX 76033-8212. **www.qrz.com/db/kc5nx**

May 21, 1300Z – 2100Z, K4S, Quicksburg, VA. Woodstock Amateur Radio Breakfast Group. **Shenandoah Caverns 100th Anniversary**. 7.040 7.240 14.040 14.240. Certificate. Carl M. Dennis, NX3A, 2224 Graveltown Rd., Quicksburg, VA 22847. **https://shenandoahcaverns.com**.

May 21, 1600Z – 2130Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. **Armed Forces Day**. 7.040 7.250 14.040 14.250. QSL. USS *Kidd* Amateur Radio Club, 305 S. River Rd., Baton Rouge, LA 70802. *Operation aboard the USS* Kidd *(DD-661)*. **www.qrz.com/db/w5kid**

May 28 – May 30, 1400Z – 2200Z, W3M, State College, PA. Nittany Amateur Radio Club. **Birthplace of Memorial Day**. 7.245 14.245. QSL. W3M c/o Nittany ARC, P.O. Box 614, State College, PA 16801. **www.qrz.com/db/w3m** and **nittany-arc.net**

May 30, 1600Z – 2130Z, W5KID, Baton Rouge, LA. Baton Rouge Amateur Radio Club. **Memorial Day Commemoration**. 7.040 7.250 14.040 14.250. QSL. USS *Kidd* Amateur Radio Club, 305 S. River Rd. Baton Rouge, LA 70802. *Operation aboard the USS* Kidd *(DD-661)*. **www.qrz.com/db/w5kid**

May 30, 1800Z – 2200Z, N3TAL, Lanham, MD. American Legion Post 275 ART. **Memorial Day Special Event**. 7.275 LSB. QSL. American Legion Post 275 ART, 8201 Martin Luther King Jr. Hwy., Lanham, MD 20706. **wa3dvo@verizon.net**

Certificates and QSL cards: To obtain a certificate from any of the special-event stations offering them, send your QSO information along with a 9 × 12-inch self-addressed, stamped envelope (3 units of postage) to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information. *Note: Some clubs may ask for a nominal fee to cover the cost of the certificate or QSL. Request will be made on air during the event or on the club's website.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**, or email information to **events@arrl.org**.

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **August** *QST* would have to be received by **June 1.** In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. **Note**: All received events are acknowledged. If you do not receive an acknowledgement within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

You can view all received Special Events at **www.arrl.org/special-event-stations**.

Volunteer Monitor Program Report

The Volunteer Monitor (VM) Program is a joint initiative between ARRL and the FCC to enhance compliance in the Amateur Radio Service. This is the February 2022 activity report of the VM Program.

♦Technician-class operators in North Attleboro, Massachusetts; Cedar Rapids, Iowa, and Broken Arrow, Oklahoma, were issued notices for FT8 operation on 20 meters. Technician licensees have no privileges on 20 meters.

♦Technician-class operators in Auburn, Indiana; Crosby, Texas; Pierre, South Dakota; Chicago, Illinois, and Mojave, California, were issued notices for FT8 operation on 7.074 MHz. Technicians have only CW privileges on 40 meters.

♦General-class operators in Pittsburgh, Pennsylvania; Phoenix, Arizona, and Hephzibah, Georgia, were issued notices for operation on 20 meters on frequencies not authorized to General-class operators.

♦The VM Program Administrator had two meetings with the FCC and participated in two amateur radio club meetings by videoconference.

♦The final totals for VM monitoring during January 2022 were 2,172 hours on HF frequencies, and 2,932 hours on VHF frequencies and above, for a total of 5,104 hours. — *Thanks to Volunteer Monitor Program Administrator Riley Hollingsworth, K4ZDH*

Melissa Stemmer, KA7CLO, mstemmer@arrl.org

At the Foundation

ARRL Foundation Board Approves Funding for Grant Proposals

Following the October 2021 grant submission period, the ARRL Foundation Board voted to approve funding for five grant proposals.

The Miami County Amateur Radio Club (MCARC) received a $2,000 award to put together six complete soldering kits to allow up to 12 club members to participate in hands-on electronics projects at club tech nights. Their hope is that instructing new and older hams in the hands-on side of amateur radio will encourage the electronics and science side of the hobby.

An $850 award was given to the Amateur Radio Club of Columbia County (ARCCC), Inc. for equipment for their HAM 101 program. The program's audience is the youth of Columbia County, Georgia. The program's purpose is to teach, and foster an interest in, amateur radio-related concepts. The program will also support youth in understanding STEM subjects and will help students to recognize the potential real-world applications.

The Sussex County Charter School for Technology in Sparta, New Jersey, was awarded $1,500 to establish the school's first amateur radio club, KD2YAQ, and to get equipment so that students can participate in more radio-related activities. The school's radio and space technology program has also been chosen for an upcoming contact with the International Space Station (ISS) in the Amateur Radio on the International Space Station (ARISS) program.

A grant of $3,000 was awarded to Comunidad del Bo. Quebradas, Inc. of Yauco, Puerto Rico, for their Amateur Radio Youth Program. The club will offer an amateur radio theory course to help participants obtain their first amateur license. Participants will take part in simple projects, applying basic electronics, radio science, and other technologies. There will also be a final team project, allowing them to integrate knowledge, creativity, and leadership skills.

ARISS-USA also received a grant. The Foundation awarded $47,533 to fund the first year of their ARISS Space Telerobotics using Amateur Radio (*STAR*) Keith Pugh Memoriam Project. This is a new 2-year STEM education program, providing opportunities for junior high and high school students. Year 1 of the program will be led by university faculty and undergraduates as they undertake systems development and initial validation, engineering hardware and software, and engaging with ARISS radios on the ISS. Year 2 of the program incorporates youth teams as they participate in hands-on robotics and radio lessons, which ideally will lead to participants earning their amateur radio license.

To learn more about the ARRL Foundation Grant Program, please visit **www.arrl.org/amateur-radio-grants** or contact Development Manager Melissa Stemmer, KA7CLO, at **mstemmer@arrl.org**.

Life Members

Elected March 21, 2022

Robert C. Bayer, W1TNH
Thomas H. Beebe, W9RY
David L. Black, AD6Q
Phillip B. Brown, KI5NTY
William E. Bussey, KJ4JJ
Ian A. Cook, WQ6D
William T. Cowan, KN4LMN
Karl T. Demuth, N8PKB
Stephen C. Demuth, KC8YBV
Derek I. Dumas, KC3NNA
Brian D. Fauber, K9BDF
Robin Felix, W1RXF
David M. Findling, KC9RM
Gregg Fine, W4GAF
Blake T. Gonzales, K8LSU
Wanda I. Gonzalez Gomez, KP4NYC
Richard M. Harrelson, WB4ULT
Paul R. Harrison, KØPRH
Lindsey A. Jasper, KB1YCM
Bill L. Johnson, AI6D
Eryk A. Kaminski, SQ5KIE
Robert S. Karz, K2OID
Jay H. Koby, KØBYJ
Chris Lance, WW2BSA
Daniel C. Larson, KD9M
Robert G. Leiden, K1UI
Dennis W. Littleton, K4DL
Dan W. Lott, KF5TQN
Duane H. Martin, KK4BZ
Donald J. McMorris, AF4H
Lance C. McNeel, W5TWM
Andrew M. Moore, NV1B
Howard L. Morgan, KC2MIO
Jeremy D. Nation, KE8TLF
Martin D. Newingham, AG3I
David Nyce, KE4CBH
Matthew B. Palmeri, AE2MP
Dan Pender, AD5DP
Justin M. Perry, KG4GFV
Mark C. Raymond, KB8UNX
Dennis A. Sandole, K2SE
Cheryl Simpson, KD6MWZ
Kenneth O. Simpson, W6KOS
Richard A. Smith, KM4RYM
Harry J. Steger, Jr., WØHMS
Erik B. Stirratt, AA9DU
David G. Taylor, N6MTX
Dan Torchia, N8FUM
William J. Vandyke, K9FOP
James Warren Wagner, KX4LW
Charles R. Wannall, KG5ITH

Certificate of Code Proficiency

Recipients

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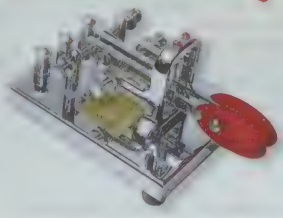


This month, ARRL recognizes merit and progress in Morse code proficiency on the part of the following individuals, who have achieved proficiency at the following rates, in words per minute.

December 2021	
Andy F. Lach, KD9KHA	10
Dave L. Rawlings, KE7JEL	10
Bruce E. Friedline, N9XAU	15
Martin Hickey, AJ6CL	15
Steven H. Saef, AA2BB/4	15
Ronald A. Weiss, W9OFF	15
Joseph DeMattei, Jr., WA1AAA	20
Gerald L. Foster, WA6BXV	20
Walter J. Schivo, KB6BKN	20
John H. Summers, Jr., WØDY	20
Ronald A. Weiss, W9OFF	20

January 2022	
Gregory Dietsche, K9CTS	10
Jerry C. Foster, Jr., KN4SYO	10
Jonathan M. Graefe, AE3JG	10
Claude W. Johnson, Jr., K8MPW	10
Justin T. McKibben, KN4PRB	10
David A. McNair, AC2WU	10
Craig H. Moody, K1CHM	10
Ernest M. Bailey, N2DGQ	15
Gary G. Gimmestad, K9KOE	15
Jack D. McCarty, WA5CHJ	15
David A. McNair, AC2WU	15
Christopher E. Johnson, WB9FXW	25
John W. Silzel, N6HCN	30
Steve D. Miller, W6SDM	35
Oliver D. Reich, W6VD	35

February 2022	
James R. Sencenbaugh, K6TPS	10
Huston D. Thompson, KØVIR	10
Daniel T. Wade, III, KD2TUD	10
James Alexanderson, KI5RNJ	15
Stephen F. Hersey, K7OFG	15
Dave L. Rawlings, KE7JEL	15
Thomas D. Taylor, N5ACA	15
Huston D. Thompson, KØVIR	15
Paul S. Hadorn, W8LY	20
William F. Paparella, Sr., KA2MLH	20
Charles Perillo, III, K2RRV	20
Thomas D. Taylor, N5ACA	20
Huston D. Thompson, KØVIR	20
Huston D. Thompson, KØVIR	25
Bruce M. Croskey, AHØU	30

Congratulations to all the recipients.

May 2022 W1AW Qualifying Runs

W1AW, the Hiram Percy Maxim Memorial Station at ARRL Headquarters in Newington, Connecticut, transmits Morse code Qualifying Runs to assist ham radio operators in increasing and perfecting their proficiency in Morse code. Amateur radio operators can earn a Certificate of Code Proficiency or endorsements by listening to W1AW Qualifying Runs.

May Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at the times shown on 1.802.5, 3.581.5, 7.047.5, 14.047.5, 18.097.5, 21.067.5, 28.067.5, 50.350, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K9JM on Wednesday May 25 at 9 PM PDT (0400 UTC on May 26) on 3590 and 7047.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Amateur radio operators who participate in Qualifying Runs may submit proof of 1 minute of the highest speed they have copied in the hope of qualifying for the Certificate of Code Proficiency, or an endorsement to their existing certificate.

Legibly copy at least 1 minute of text by hand, and mail the sheet to: W1AW Qualifying Runs, 225 Main St., Newington, CT USA 06111.

Include $10 (check or money order) if this is a submission for your initial Code Proficiency certificate; $7.50 if you are applying for an endorsement (available for speeds up to 40 WPM). Your test will be checked against the actual transmissions to determine if you have qualified.

Members of the North Fulton (Georgia) Amateur Radio League (**https://nfarl.org**) are offering to subsidize the total cost of a Code Proficiency certificate or endorsement submission for any individual age 21 years and younger, and who reside in either the US or Canada. Participants who wish to make use of this offer should indicate on their qualifying run submissions they are age 21 or younger, and certify as such via their signature. Eligible participants are not required to send any fee with their Code Proficiency submissions.

For more information about Qualifying Runs, please visit **www.arrl.org/qualifying-run-schedule**.

For information about how to qualify for the Certificate of Code Proficiency, please visit **www.arrl.org/code-proficiency-certificate**.

W1AW Qualifying Runs — May 2022
(All times are in Eastern Daylight Time)

Monday	Tuesday	Wednesday	Thursday	Friday
5/2 4 PM – 2000Z 10 – 35 WPM	**5/3** 7 PM – 2300Z 35 – 10 WPM			**5/6** 9 AM – 1300Z 10 – 35 WPM
	5/10 4 PM – 2000Z 10 – 35 WPM	**5/11** 7 PM – 2300Z 10 – 40 WPM	**5/12** 9 AM – 1300Z 35 – 10 WPM	**5/13** 10 PM – 0200Z **(5/14 – UTC)** 10 – 35 WPM
	5/17 9 AM – 1300Z 10 – 35 WPM	**5/18** 10 PM – 0200Z **(5/19 – UTC)** 35 – 10 WPM	**5/19** 7 PM – 2300Z 10 – 35 WPM	**5/20** 4 PM – 2000Z 10 – 40 WPM
	5/24 9 AM – 1300Z 35 – 10 WPM		**5/26** 4 PM – 2000Z 35 – 10 WPM	**5/27** 7 PM – 2300Z 10 – 35 WPM

Convention and Hamfest Calendar

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

Abbreviation

Spr = Sponsor
Tl = Talk-in frequency
Adm = Admissio

Arizona (Prescott Valley) — May 14 D F H Q R T V
8 AM – noon. *Spr:* Yavapai ARC, Amateur Radio Council of Arizona. Granville Elementary School, 5250 Stover Dr. *Tl:* 146.880 (100 Hz), 447.650 (100 Hz), 146.580 simplex. *Adm:* $5. **www.prescotthamfest.com**

Colorado (Delta) — June 4 T
8 AM – 11 AM. *Spr:* Montrose ARC. Lions Club Pavilion, 510 Palmer St. *Tl:* 147.195 (107.2 Hz). *Adm:* Free. **www.montrosehamradio.org**

Connecticut (Goshen) — May 21 D F H R T V
8 AM – noon. *Spr:* Southern Berkshire ARC. Goshen Fairgrounds, 116 Old Middle St. (CT Route 63). *Tl:* 147.285 (77.0 Hz). *Adm:* $5. **www.sberk.org**

Florida (Dade City) — May 7 F H T V
7 AM – noon. *Spr:* East Pasco ARS. Church Ave. parking lot, 37444 Church Ave. *Tl:* 146.880 (146.2 Hz). *Adm:* $5. **www.eparsonline.org**

Florida (Pinellas Park) — May 28 F R T
8 AM – noon. *Spr:* The Glorious Society of the Wormhole. Freedom Lake Park, 9990 N. 46th St. *Tl:* 146.850 (146.2 Hz). *Adm:* Free. **www.w4orm.org**

ARRL GEORGIA STATE CONVENTION

June 4, Marietta, Georgia
D F H Q R S T V
8 AM – 3 PM. *Sprs:* Atlanta Radio Club, Kennehoochee ARC. Jim Miller Park, 2245 Callaway Rd. *Tl:* 146.820 (146.2 Hz). *Adm:* $8. **www.atlantahamfest.com**

Idaho (Salmon) — Apr. 28 – May 1 F H T V
9 AM – 7 PM. *Spr:* Lemhi ARC. Whitewater Arena, Cemetery Rd. *Tl:* 146.98 (100.0 Hz), 146.52. *Adm:* Free. Email: **kl7ut@pm.me**

Illinois (Mendota) — June 5 D F H R T V
8 AM – 3 PM. *Spr:* Starved Rock Radio Club. Mendota Tri-County Fairgrounds, 503 First Ave. *Tl:* 147.120 (103.5 Hz). *Adm:* $7 advance, $8 door. **www.w9mks.org**

Maryland (Boonsboro) — Apr. 30 D F H Q R S T V
7 AM – 2 PM. *Spr:* Antietam Radio Association. Washington County Agricultural Education Center, 7313 Sharpsburg Pike. *Tl:* 147.09, 146.94 (100 Hz). *Adm:* $7. **www.w3cwc.org**

Michigan (Chelsea) — June 5 D H Q R T V
8 AM – noon. *Spr:* Chelsea Amateur Radio Club. Chelsea Community Fairgrounds, 20501 W. Old US Hwy 12. *Tl:* 145.450, 146.980 (100 Hz). *Adm:* $5. **www.wd8iel.com**

Michigan (Ferndale) — June 5 D F H R T V
9 AM – 1 PM. *Spr:* K8FBI Radio Club. Fraternal Order of Police Lodge 130, 2233 Burdette St. *Tl:* 442.600 (123 Hz). *Adm:* Free. **www.flyingbeers.org**

Michigan (Hudsonville) — June 4 D F H R T V
8 AM – noon. *Spr:* Independent Repeater Association. Hudsonville Fairgrounds, 5235 Park Ave. *Tl:* 147.16 (94.8 Hz). *Adm:* $8. **www.w8ira.org**

Michigan (Shelby Township) — May 21 D F
8 AM – noon. *Spr:* GM ARC. Packard Proving Grounds Historic Site, 49965 Van Dyke Ave. *Tl:* 443.075 (123 Hz). *Adm:* $5 per carload buying or selling. **www.gmarc.org**

Missouri (Springfield) — June 4 D F H R S T V
8 AM – 1 PM. *Spr:* Southwest Missouri ARC. Salvation Army Springfield Headquarters, 1707 W. Chestnut Expressway. *Tl:* 146.910 (162.2 Hz). *Adm:* $5 advance, $7 door. **www.smarc.org**

ARRL NEBRASKA STATE CONVENTION

May 14, Lincoln, Nebraska
D F H Q R S V
8 AM – 5 PM. *Spr:* Lincoln ARC. Lancaster Events Center, 4100 N. 84th St. *Tl:* 146.760. *Adm:* $8. Free if under 16 years of age. **www.lincolnhamfest.org**

Nevada (Minden) — June 4 F
6:30 AM – noon. *Spr:* N7RCA. 1780 Bobcat Ct. *Tl:* none. *Adm:* Free. **www.n7rca.com**

Nevada (Verdi) — May 21 D F
8 AM. *Spr:* Sierra Nevada ARS. Cabela's, 8650 Boomtown Garson Rd. *Tl:* 147.210 (100 Hz), DMR TG31328. *Adm:* Free. **www.renohamswap.com**

New Jersey (Fair Lawn) — June 4 D F H Q R T
8 AM. *Spr:* Fair Lawn ARC. Memorial Pool south parking lot, Essex St. and Bellair Ave. *Tl:* 145.470 (167.9 Hz). *Adm:* $5. **www.flarchamfest.com**

New Mexico (Clovis) — May 28 F H R S T V
8:30 AM – 4 PM. *Spr:* Eastern New Mexico ARC. Trinity Lutheran Church, 1705 West 19th St. *Tl:* 443.45 (131.5 Hz). *Adm:* Free. **www.ka5b.org**

New Mexico (Pena Blanca) — May 6 – 8 F H R S T
8 AM – 5 PM. *Spr:* High Desert Amateur Radio of New Mexico, Inc. Buffalo Grove Loop Space 58 and 59 at Cochiti Campground at Cochiti Lake State Park, NM16. *Tl:* 146.460 simplex, 145.290 (100 Hz). *Adm:* Free. **www.nm5hd.org**

New Mexico (Roswell) — May 21
8 AM – 1 PM. *Spr:* Pecos Valley ARC. Beginnings, 3908 SE Main St. *Tl:* 147.320 (146.2 Hz). *Adm:* $5. **www.pecosvalleyarc.com/alien-city-hamfest-2022**

New York (Depauville) — May 21 F H R S T V
8 AM – noon. *Spr:* Thousand Islands Repeater Club. Depauville Fire Dept. Community Center, 15231 School St. *Tl:* 147.030 (151.4 Hz). *Adm:* $2. **www.tirepeaterclub.com**

New York (Hilton) — June 4 D F H Q R T V
7 AM – 2 PM. *Spr:* Rochester Amateur Radio Association. Hilton Exempt Club, 137 South Ave. *Tl:* 146.61 (110.9 Hz). *Adm:* $10. **www.rochesterham.org/hamfest.htm**

New York (Palmyra) — Apr. 30 D F H R T
8 AM – 1 PM. *Spr:* Drumlins ARC. Palmyra VFW Post #6778, 4306 Route 31. *Tl:* 146.745 (71.9 Hz). *Adm:* $5. **www.drumlinsarc.us**

Ohio (Toledo) — May 1 F
9 AM – noon. *Spr:* Lucas County ARES. Toledo Speedway, 5639 Benore Rd. *Tl:* 146.61 (103.5). *Adm:* $5. **www.tinyurl.com/lcaresswap**

Ohio (Wauseon) — June 4 D F H R T V
8 AM – 1 PM. *Spr:* Fulton County ARC. Roth Family Woodlot, 105 Hill Ave. *Tl:* 147.195 (103.5 Hz). *Adm:* $5. **www.k8bxq.org/hamfest**

Ohio (Xenia) — May 20 – 21 D F H Q R S V
Fri. 9 AM – 5 PM, Sat. 9 AM – 5 PM, Sun. 9 AM –1 PM. *Spr:* Dayton ARA. Greene County Fairgrounds and Expo Center, 120 Fairgrounds Rd. *Tl:* 146.94 (123.0 Hz). *Adm:* $26 advance, $31 door. **www.hamvention.org**

ARRL NORTHWEST DIVISION CONVENTION

June 3 – 5, Seaside, Oregon
D F H Q R S
Fri. workshop only, Sat. 9 AM – 4 PM, Sun. 9 AM – 1 PM. *Sprs:* Oregon Tualatin Valley ARC, Clark County ARC. Seaside Civic & Convention Center, 415 First Ave. *Tl:* 145.45 (118.8 Hz), 146.52 simplex. *Adm:* $10 advance; $15 door; student $5, and children under 12 free. **www.seapac.org**

South Dakota (Huron) — June 4 H T V
8 AM – 7 PM. *Spr:* Huron Amateur Radio Association. Beadle County Sportsman's Club, 7th St. and Lawnridge Ave. NE. *Tl:* 146.82 (146.2 Hz). *Adm:* Free. Email: **wb0ulx@santel.net**

Virginia (Manassas Park) — June 4 D Q R S T V
6:30 AM – 12:30 PM. *Spr:* Ole Virginia Hams. Manassas Park Community Center, 99 Adams St. *Tl:* 146.970 (no PL). *Adm:* $9 advance, $10 door. **www.manassashamfest.com**

Washington (Peshastin) — June 10 – 12 D R S T V
All day. *Spr:* Apple City ARC. Dryden Gun Club, 7649 Saunders Rd. *Tl:* 146.680 (156.7 Hz). *Adm:* $8. **www.applecityarc.com**

Washington (Stanwood) — May 14 F H R
8 AM – 1 PM. *Spr:* Stanwood Camano ARC. Stanwood Camano Fairgrounds, 6431 Pioneer Hwy. *Tl:* 147.360 (127.3 Hz). *Adm:* $5. **www.scarcwa.org**

West Virginia (Ripley) — May 1 D F H R T V
8 AM – 2 PM. *Spr:* Jackson County ARC. Ripley Middle School, West School St. *Tl:* 146.67 (107.2 Hz). *Adm:* $5. **www.jcarc.net**

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 years in advance.

Events that are sanctioned by ARRL receive special benefits, including an announcement in these listings and online. Sanctioned conventions are also listed in *The ARRL Letter.* In addition, events receive donated ARRL prize certificates and handouts. Once the form has been submitted, your ARRL Director will decide whether to approve the date and provide ARRL sanction.

The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **June 1** to be listed in the **August** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, driving directions, and other event details. Please note that postal regulations prohibit mention in *QST* of games of chance, such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to special discounted rates on *QST* display advertising and ARRL web banner advertising. Call ARRL's toll-free number at 1-800-243-7768, or email **ads@arrl.org**.

New Books

Wes Schum: Amateur Radio's Unsung Hero

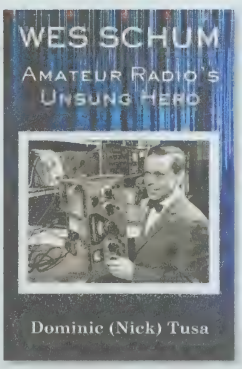
Dominic "Nick" Tusa, K5EF

Reviewed by Steve Ford, WB8IMY

If you explore the history of SSB, you'll likely encounter Wes Schum, W9DYV. Schum was not only among the pioneers of SSB, he also established Central Electronics, a company that would manufacture the first amateur radio SSB transmitters and receivers.

Author Nick Tusa, K5EF, knew Schum well, and in his new book, *Wes Schum: Amateur Radio's Unsung Hero*, he combines his own research into Schum's life with accounts obtained directly from the man himself. Tusa tells Schum's story, but he also occasionally dives into details about the technology that would make Central Electronics a renowned manufacturer in the late '50s and early '60s.

Tusa takes the reader on a fascinating journey, from Schum's childhood during the prohibition movement, to his developing passion for electronics and amateur radio. By the time he was a young adult, Schum was employed as a design engineer with Cover Digital-Signal in Chicago, where he developed wireless emergency alarms for the military as the US prepared to enter World War II. He was also instrumental in perfecting *paravanes*, towed underwater "gliders" with explosives that were used to help protect convoys from enemy submarine torpedoes. Tusa shares the story of how Schum's prowess in electronics kept him out of uniform during the war, although he was drafted into the army immediately afterward.



The postwar SSB boom eventually resulted in Schum creating Central Electronics and rolling out the famous 10A exciter, followed by a series of quality amateur products. Schum's company was later acquired by Zenith but ultimately closed in 1962. Tusa describes the bitter episode as having a lasting impact on Schum, despite the fact that he soon went on to create Schum Electronics.

Tusa's conversational style makes *Wes Schum: Amateur Radio's Unsung Hero* an engaging read. The book includes numerous photographs, technical details, and tips for restoring vintage Central Electronics gear.

Wes Schum: Amateur Radio's Unsung Hero, Jan-Carol Publishing, Inc. (**www.jancarolpublishing.com**). Also available from Amazon (paperback $20; hardcover $34.95; Kindle $9.99) and Barnes & Noble.

W1AW Schedule

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1300		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-12^{45} PM	8 AM-1^{45} PM	9 AM-2^{45} PM	10 AM-3^{45} PM	1400-1945	VISITING OPERATOR TIME				
1 PM	2 PM	3 PM	4 PM	2000	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2100	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2200	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	2300	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0000	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0100	DIGITAL BULLETIN				
6^{45} PM	7^{45} PM	8^{45} PM	9^{45} PM	0145	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0200	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0300	CODE BULLETIN				

W1AW's schedule is at the same local time throughout the year. From the second Sunday in March to the first Sunday in November, UTC = Eastern US time + 4 hours. For the rest of the year, UTC = Eastern US time + 5 hours.

♦ Morse code transmissions: Frequencies are 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, 50.350, and 147.555 MHz.

Slow Code = practice sent at 5, 7½, 10, 13, and 15 WPM.

Fast Code = practice sent at 35, 30, 25, 20, 15, 13, and 10 WPM.

Code bulletins are sent at 18 WPM.

For more information, visit us at
www.arrl.org/w1aw

♦ W1AW Qualifying Runs are sent on the same frequencies as the Morse code transmissions. West Coast qualifying runs are transmitted by various West Coast stations on CW frequencies that are normally used by W1AW, in addition to 3590 kHz, at various times. Underline 1 minute of the highest speed you copied, certify that your copy was made without aid, and send it to ARRL for grading. Please include your name, call sign (if any), and complete mailing address. Fees: $10 for a certificate, $7.50 for endorsements.

♦ Digital transmissions: Frequencies are 3.5975, 7.095, 14.095, 18.1025, 21.095, 28.095, 50.350, and 147.555 MHz.

Bulletins are sent using 45.45-baud Baudot, PSK31 in BPSK mode, and MFSK16 on a daily revolving schedule.

Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern time using Baudot and PSK31.

♦ Voice transmissions: Frequencies are 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59, 50.350, and 147.555 MHz. Voice transmissions on 7.290 MHz are in AM double sideband, full carrier.

♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to 3:45 PM Monday through Friday. FCC-licensed amateurs may operate the station during that time. Be sure to bring a reference copy of your current FCC amateur license. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour, and CW on the half hour.

W1AW code practice and CW/digital/phone bulletin transmission audio is also available real-time via the *EchoLink Conference Server* W1AWBDCT. The conference server runs concurrently with the regularly scheduled station transmissions. The W1AW Qualifying Run texts can also be copied via the EchoLink Conference Server.

During 2022, Headquarters and W1AW are closed on New Year's Day (observed December 31, 2021), Presidents Day (February 21), Memorial Day (May 30), Independence Day (July 4), Labor Day (September 5), Veterans Day (November 11), Thanksgiving and the following day (November 24 and 25), and Christmas Day (observed December 26).

A Look Back

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•Gimmicks and Gadgets

An IC Audio Tune-Up Device for the Blind Amateur

This photograph shows how small the unit is.

A Simple Unit for Use with the HW-16 and Other Rigs

BY THOMAS P. RILEY,* WA1BYM

SEVERAL ARTICLES have been published concerning tuning devices for blind amateurs. When a sightless friend got his Novice ticket, I decided to build such a circuit for him. After researching some of the published articles on the subject it became apparent that most of the circuits were unnecessarily complex and outdated, as compared with the availability of present-day integrated circuits. The circuit, Fig. 1, was used in conjunction with the HW-16 transceiver, but can easily be adapted to almost any transmitter. It utilizes one monolithic integrated circuit which is available for $2.60.[1]

How It Works

The unit provides an output tone whose frequency is proportional to the meter deflection on the HW-16. Thus, it can be used to dip the final or peak the relative output power. In addition, a reference frequency is provided which is set to give that frequency which corresponds to the plate current for 75-watts input power. The operator can resonate the final, then adjust the power level for 75-watts input.

The IC is a dual-voltage controlled multivibrator (VCM) which is intended for use in a phase-locked loop. It lends itself ideally to this application. The multivibrator provides a square-wave output whose frequency is proportional to the dc voltage applied to its input. The output stage of the device is a TTL driver which can be short circuited indefinitely without damage to the device. Thus, a loudspeaker may be connected directly to the output and sufficient volume is obtained without the need for an additional audio amplifier. Although the output is a square wave, the tone is quite acceptable.

* 12 Tickle Road, Westport, MA 02790.

1 The author is equipped to furnish an etched circuit board and a kit of parts for a nominal charge. Address your requests to Thomas Riley, 12 Tickle Rd., Westport, MA 02790.

The 0.1-μF capacitor, C4, is used to set the output frequency range of the oscillator; in this case it is approximately 1000 to 4000 Hertz (the center of the human hearing range). Since the HW-16 has no built-in loudspeaker, it was decided to use the same speaker for both the receiver and tuning circuit. A dpdt switch performs the necessary switching for the speaker and also applies power to the circuit. When switch S2 is in the REF (reference) position, the input of the oscillator is connected to the wiper arm of a 10-kΩ potentiometer (actually, any value between 5-kΩ and 100-kΩ will do). This provides a variable dc voltage which in turn is used to set the oscillator frequency to any value within its 1- to 4-kHz range. When the switch is in the XMTR position, the input of the oscillator is connected to the meter in the transmitter. A 3 mA, 1000-ohm meter is used in the HW-16 and therefore develops a voltage drop across it of 3 volts at full scale. The voltage-controlled multivibrator, however, is insensitive to input voltages between 0 and 2 volts, and actually delivers its full output frequency range for input voltages between 2 and 5 volts. The combination of diodes CR1, CR2, and CR3 and the 100-kΩ resistor provide a level shift caused by the voltage drop across the diodes. The junction of the diode and resistor varies from 2 to 5 volts for inputs of 0 to 3 volts and is thus within the desired range for VCM. C1, C2, and C3 bypass any rf which may have been picked up in the interconnecting wiring. These should be placed as close to the IC as possible. It was found that on 15 meters a considerable amount of rf was getting on the power leads and dc input to the oscillator, adversely affecting its operation. Addition of the bypass capacitors corrected the problem.

Power is obtained from a 6-volt battery and it is suggested that battery operation be used. Diode CR4 drops about 0.75 volts thus delivering about 5.25 volts to the circuit. Power consumption is on the order of 30 mA. Since the unit draws so little power and is in operation only a small amount of time, battery life is quite high. The first battery

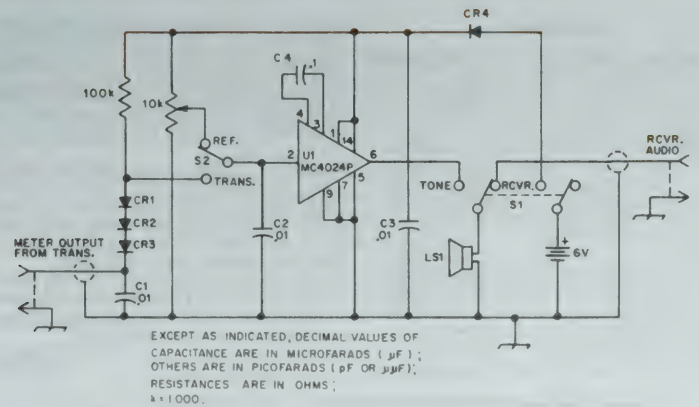

Fig. 1 — Circuit diagram of the tuning aid.
BT1 — 6-volt battery.
C1, C2, C3 — .01-μF disk ceramic, 1000 V.
CR1, CR2, CR3, CR4 — 1N914 or equiv.
R1 — 100-kΩ 1/2-watt carbon resistor.
R2 — 10-kΩ potentiometer, preferably multiturn trimmer.
S1 — Dpdt toggle or slide switch.
S2 — Spdt toggle or slide switch.
U1 — Integrated circuit, Motorola MC4024P.

used was a small mercury cell which lasted a year. Four C or D cells should last in excess of a year.

One attempt was made to power the circuit from the 6.3-V ac accessory output of the transceiver. A full-wave rectifier, capacitor filter and Zener diode regulator were used. However, the small amount of ripple on the power supply showed up as a 120-Hz modulation on the oscillator output. Rather than incorporate an elaborate voltage regulator, it seemed easier and more economical to use batteries, which has proven quite successful.

HW-16 Changes

Only one small addition is required on the transceiver. This is to provide a means of getting access to the meter circuitry. Connect a piece of hookup wire from the positive terminal of the meter, through a grommet in the chassis, and to an unused pin on the accessory socket. In addition, connect a .01-μF disk ceramic capacitor from the pin on the socket to chassis ground.

Calibration

Calibration must be done by a sighted amateur and should be checked about every six months. Battery degradation causes a change in the reference frequency. However, this change is not as great as one might expect because the output frequency is not dependent on the absolute input voltage to the oscillator but is more closely related to the ratio between the input and power-supply voltages. Since this ratio is fixed by the potentiometer, the frequency change is very small. Also, the frequency change is in a negative direction so that as the battery gets weaker, the reference frequency would correspond to a lower input power level. This prevents damage to the final and guarantees that the Novice regulation of 75 watts maximum input is not exceeded.

The transmitter should be tuned up in a normal fashion into a dummy load. The **POWER-LEVEL** control is then set to give a plate current reading of exactly 125 mA (red mark on meter scale) which corresponds to 75 watts input. Key the transmitter and leave it on. Turn the tuning circuit on and slowly adjust the setting of the reference potentiometer while switching S2 back and forth. When the same tone is heard with S2 in either position shut the tuning circuit off and release the key on the transmitter. The circuit is now calibrated and ready for operation.

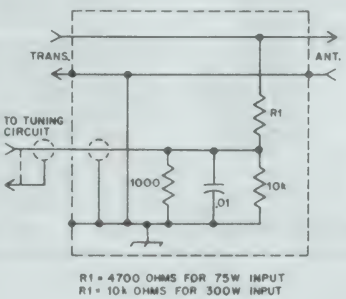

Fig. 2 — Circuit for use with tuning unit for relative output indication.

Operation

Operation is quite simple and straightforward. The tuning circuit is turned on with S2 in the XMTR position. Set the meter switch to PLATE and the POWER LEVEL control to minimum. Key the transmitter and adjust the TUNE control for minimum pitch (plate current dip). The POWER LEVEL is then increased slowly while switching S2 back and forth. When the two tones are equal, release the transmitter key and shut the tuning circuit off. The transmitter is now tuned up to a final input power of 75 watts.

The unit will also monitor relative output power by setting the meter switch to that position. The reference frequency of course has no bearing when using the unit in this fashion, and the TUNE control is adjusted to give the highest output pitch.

The circuit is not limited to use with the HW-16 transceiver, and can be used with almost any transmitter. If the meter circuitry is similar to that of the HW-16 (i.e., the negative terminal of the meter is grounded and the meter provides approximately 3 V full scale) the unit can be used as is. If not, a suitable resistor can be placed in the cathode circuit of the final to develop a voltage drop of approximately 3 volts for full-scale deflection of the existing meter.

In any case, if it is not practical to modify an existing transmitter, the unit may be used to monitor relative output power. In this case the reference potentiometer and switch S2 are not required. The circuit at Fig. 2 may be used in conjunction with the tuner for that purpose.

A special note of thanks goes to John Pavao, WA1LPM, for whom I designed the circuit and who encouraged me to write this article so that other sightless hams may benefit from it.

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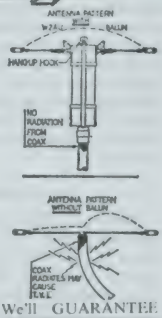

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Celebrating Our Legacy

My Mentor Gave Me a Second Chance at Radio

I first became interested in ham radio when I was a pre-teen. But it wasn't until a little later in life that I found a mentor to help me earn my license.

Following my military discharge after high school, I became an announcer at the local radio station in a city near my hometown. The station's chief engineer was a ham, and we became casual friends. After working as an announcer, I went to college and became a teacher.

I decided to reach out to the chief engineer to find out how I could earn my ham radio license, and he became my mentor. He helped me with the Novice study materials, explaining everything in clear and understandable language. On Friday nights, he helped me practice Morse code in his shack. I also practiced at home.

One Friday evening (the same night as the Apollo 1 launchpad fire), he gave me the Novice-class license test. He told me to copy the code he sent, which was 9 WPM. Then, I nervously completed the written test. I passed, and he mailed the paperwork to the FCC.

A couple of months later, I received my FCC license in the mail. I was finally a ham! We owe every mentor a "thank you" for teaching us over the years, as not every ham is willing to do so. Amateur radio wouldn't be the same without its wonderful community of mentors.

Art Pahr, K9XJ
Plymouth, Wisconsin
Life Member

Over 6 Decades of Ham Radio Memories

In 1957, at just 15 years old, I met my mentor George, W3JLM, through a close friend. I practiced Morse code by building a small code practice oscillator with a small earphone and key built in, and it was built with a transistor circuit. I practiced every day by sending words I saw on buildings or billboards as I traveled to and from school. I would also send everything that I could see or hear inside the classroom.

When I was in Boy Scouts, my Scoutmaster caught the ham radio bug from me and started a class for the Scouts in our troop. A number of my fellow Scouts earned their licenses, but my Scoutmaster and I were the only ones who pursued the hobby any further.

In order to take my license exam, I had to ride the bus for 75 miles to the closest FCC office. I passed the exam, copying 5 WPM. I waited to receive my license in the mail for weeks. After it arrived, I put up dipoles for 80 and 40 meters.

My mentor helped me build my first transmitter — a homebrew three tube 6L6 unit with plug-in coils. I was able to operate CW on the Novice bands with it. My receiver was an ARC-5 for each band, and I later began using the matching transmitters. I would operate CW during the weeknights while I did my homework.

When I was ready to upgrade to my General-class license, I built a Heathkit DX-40 transmitter that had a phone position on the operating switch. I failed my first attempt at the 13 WPM CW exam. Typically, you have to wait 30 days before retaking it, but the examiner was kind enough to let me take it again that day, and I passed!

A few years later, I moved to Florida and joined the Navy. I learned a lot about electronics and operated SSB using the AN/URC-32 shipboard transceiver. I also handled phone patches for crew members to contact their families. I retired from the Navy after 29 years of service.

After 63 years of ham radio experience, I'm still learning new things and trying new operating modes. I'm lucky to have witnessed the marvelous advancements of electronics and equipment over the years!

Ted Wirick, W4YJC
Macclenny, Florida

My Most Memorable QSO

In 1969, I was a relatively new ham. One day, I tuned my radio to the CW band on 15 meters, and a weak station came on the frequency and started calling CQ. His call was DL5BA — a German station. I had never contacted Germany before.

We exchanged RST (Readability-Signal Strength-Tone), names, and locations. After he received my report, he told me that he had a friend in his shack from my hometown, which was Columbus, Mississippi, at the time. I asked him if his friend's name was Hank, and he said yes.

Hank and I had never met, but the night before this contact, my friend and his girlfriend were at my house for supper, and his girlfriend told us that she rarely saw her dad because he was in the service and was usually overseas. At the time, he was stationed in Germany. It turned out that she was Hank's daughter. Through DL5BA, we spent the next several minutes talking about his family.

I spoke to Hank a few months later, when he was home on furlough. He said that was a special day, and we both remarked about the odds of that contact taking place, but we were both glad that it did!

George Winship, NC5G
Gallatin, Texas
Life Member

Send reminiscences of your early days in radio to "Celebrating Our Legacy," ARRL, 225 Main St., Newington, CT 06111 or **celebrate@arrl.org**. Submissions selected for publication will be edited for space and clarity. Material published in "Celebrating Our Legacy" may also appear in other ARRL media. The publishers of *QST* assume no responsibility for statements made in this column.

Dennis W. Berg, WB9MSM, comichaven@charter.net

A Brief History of Swan Electronics

Swan Electronics was originally called Swan Engineering when Herbert Johnson, W6QKI, founded the company in his garage in Arizona in late 1960. Johnson was a visionary who wanted to be the "manufacturer of choice" for quality and affordable amateur radio equipment.

Swan was breaking into the high-frequency (HF) single-sideband (SSB) market at a time when amplitude modulation (AM) was the mode of voice communication for amateurs on the ham bands. AM would soon see its demise as more and more SSB stations started to populate the amateur bands in the early 1960s.

ONCE AGAIN SWAN LEADS THE FIELD BY INTRODUCING THE MOST TREMENDOUS TRANSCEIVER VALUE EVER OFFERED TO THE RADIO AMATEUR!
If you want the finest voice quality with maximum talk power at the most reasonable price . . . then you must see
THE NEW SWAN-350 TRANSCEIVER
5 BANDS — 400 WATTS — $395
HOME STATION — MOBILE — PORTABLE
SWAN SPEAKS YOUR LANGUAGE and continues to set the pace with unequalled performance, proven reliability and superior craftmanship.
ASK THE HAM WHO OWNS ONE!
ACCESSORIES:
SEE THE NEW SWAN-350 and THE DELUXE SWAN-400 AT YOUR DEALERS NOW!
SWAN ELECTRONICS CORP.
103

Figure 1 — A November 1964 *QST* ad for the five-band, 400 W SWAN-350 transceiver.

A Leader in a Competing Market

Manufacturing SSB equipment put Swan in a great position among competitors. It was easier for the average ham to afford a Swan radio in comparison to buying a Collins radio. The significant cost differences allowed Swan to take a strong lead in selling transceivers.

In 1964, a Swan model 350 transceiver (see Figure 1), along with a 117C power supply, was selling for $480. A Collins KWM-2 transceiver of comparable capabilities sold for $1,150. (Both are 1964-era prices.) With a range of quality and affordable radios, Swan was a leader among several competing brands. Two standout competing products included the Hallicrafters SR-150 transceiver with power supply for $750 and a Heathkit SB-300 receiver with the SB-400 transmitter selling for $665.

Figure 2 — The 1972 spring catalog for Swan Electronics.

Swan Radios Production

Swan was a leading manufacturer of ham radios and accessories for over 20 years, with a large customer base that stretched across the world. In 1967, at the height of their popularity, the workforce was in the range of around 160 employees, and the manufacturing site produced over 400 radio transceivers per month. Swan experienced a rapid expansion of its workforce due to an increased demand for their radios and accessories. Radios were built by a very orderly and quality-oriented workforce. Herbert Johnson's priority was attention to detail, and he set a high standard for employees. This was reflected in the consistent customer satisfaction reviews.

In the 1960s, most radios on the market produced a 180 W input. Swan Electronics radios were built to deliver high power. Swan radios produced between 300 – 500 W input, which became a game changer for Swan. Swan utilized *sweep tubes*, which were known for their high-power capability. Because they were used in televisions sets at the time, they were readily available for production. Swan took advantage of this and began using sweep tubes in the final amplifier stage of their radios. Sweep tubes were placed in Swan radios mainly due to their lower cost, plus they were capable of handling three times the power of other RF tubes available during this time.

Swan's Equipment Lineup

Swan had a nice lineup of transceivers during its manufacturing years. In 1961, their transceivers included the monobanders like the SW-120 for 20 meters, the SW-140 for 40 meters, and the SW-175 for 75 meters. In 1963, their SW-240 triband transceiver was launched. It provided coverage for 20, 40 and 75 meters. In 1964, the five-band Swan 400 transceiver delivered 10 – 80 meters with 400 W input.

Over the years Swan delivered a very full range of equipment that included transceivers, transmitters, receivers, and linear amplifiers (see Figure 2). Swan was known to continually improve their existing equipment by enhancing quality and providing additional features along with their continued efforts to keep affordability at the forefront of their product line. Swan also expanded its product line to include accessories, such as microphones and frequency counters.

Figure 3 — Dennis Berg, WB9MSM, with his 1970s-era Swan 500CX and Swan 700CX. The Swan 500CX with the SS-16 special filter is used for CW. The 700CX with the SS-16B special filter is used for SSB.

An End for Swan Electronics

In 1968, Swan Electronics became a subsidiary of Cubic Corporation to expand financial and manpower resources. The merge allowed for Swan to compete at a higher level with the upgrade of their radios and accessories, as seen with the 1970s-era Swan 500CX and Swan 700CX (see Figure 3). However, Swan's success soon began to diminish.

Founder Herbert Johnson left in 1973, founding a competing company, Atlas Radio, in 1974. The market shifted drastically in the mid-1970s with the emergence of solid-state transceivers. All US amateur radio manufactures faced a very difficult time when Eastern Asian manufacturers entered the manufacturing arena.

One by one, US-based companies ceased manufacturing operations. Swan was no different. Their last tube-design radio was the 1982 Swan HF-700S. Swan continued with solid-state for a while, producing and marketing equipment under the Cubic name before disappearing from the amateur radio landscape altogether.

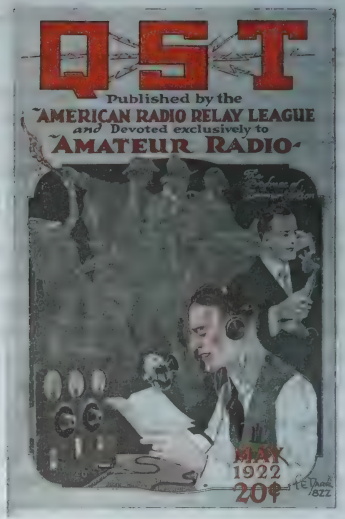
In an effort to make this content more accessible to readers, author Dennis W. Berg, WB9MSM (see Figure 3), produced an audio recording of this article. It can be found at **www.arrl.org/qst-in-depth**.

All photos by the author.

Further Resources on Swan Electronics Radios

- A Swan Tube Transceiver Compendium, which has a collection of technical data, was compiled by Robert Bolonis, and is available at **https://mmg-garden-rr.webs.com/Documents%20-%20Ham/Swan CompendiumRev4.pdf**.
- A Swan Facebook Group is available at **www.facebook.com/groups/SwanElectronics**.
- A Swan email group is available at **https://groups.io/g/SwanNetwork**.

100, 50, and 25 Years Ago



May 1922

- The cover art illustrates "The Progress of Communication."
- The editorial addresses the wild expansion of radio listening, which is causing shortages of available equipment.
- "3ZO---An Amateur Paradise" describes the admirable station of Horace A. Beale, Jr., of Parkesburg, Pennsylvania.
- H. J. Goddard, 9ZX/9EE, explains "An Efficient Tuner for Short Waves."
- K. B. Warner provides a report on "The Governors-President Relay."
- ARRL Traffic Manager F. H. Schnell announces the "Police Chiefs Relay."
- Harold L. Olesen, Ex-2BQT, presents "An Electromagnetic Changeover Switch."
- Philip R. Coursey presents a "Report on Receptions by British Amateurs in the Transatlantic Tests, December, 1921."
- S. Kruse and D. W. Richardson discuss "The Importance of Higher Voltages for Amateur Spark Communication."

May 1972

- The cover photo shows the VXO described in this issue.
- The editorial discusses public relations and amateur radio.
- Wes Hayward, W7ZOI, shares how to get "Increased Power for the Solid-State Transmitter."
- Hap King, W7QCV, explains the "Conversion of Telefax Transceivers to Amateur Service."
- Don V. Watters, VE2HW, presents "A Coaxial-Line Amplifier for 220 MHz."
- Douglas A. Blakeslee, W1KLK, shares a short primer in optoelectronics, in "By the Light of a Diode."
- Roy C. Hejhall, K7QWR, discusses "Some 2-Meter Solid-State Rf Power-Amplifier Circuits."
- Harlan Bercovi, WØMYN, reveals "How to Handle Telephone Interference," a common problem nowadays.
- Richard T. Knadle, Jr., K2RIW, offers Part II of "A Strip-Line Kilowatt Amplifier for 432 MHz."
- John Mason, W5NSQ, shares his thoughts, in "Towards a National Plan for 2-meter Fm Channels."
- William I. Dunkerley, Jr., WA2INB, explains "How to Get Ready for Oscar DX."

May 1997

- The cover photo shows a 300-W Class-E amplifier described in this issue.
- The editorial discusses "Public Service in the 21st Century."
- Don Daso, K4ZA, explains how the crew at N4ZC used a helium balloon as "A Skyhook for the '90s."
- Charles Kitchin, N1TEV, and Mike Murphy, WB2UID, describe "An Ultra Simple W1AW Receiver."
- Neil Heckt presents "A PIC-Based Digital Frequency Display."
- Eileen Lau, KE6VWU, et al., provide Part 1 of "High-Efficiency Class-E Power Amplifiers."
- Terry J. Taylor, W5JFM, in "Twister, a la Antenna!," shares how to get a VHF/UHF antenna up in the air.
- Nizar A. Mullani, KØNM, discusses "The Bent Dipole."
- In "The Mini-Five Beam," Lee Aurick, W1SE, describes a compact 2-meter beam that's ideal for attic installation.
- Donald Cox, AA3EK, discusses high-precision time services, in "Time on Your Side."

Silent Keys

It is with deep regret that we record the passing of these radio amateurs:

K1BYD **Warner**, Stephen A., Massillon, OH
K1CN **Welch**, William R., Osterville, MA
K1EJ **Mallory**, Darrel D., North Chelmsford, MA
KA1HPM **Szydlek**, Nicholas, Pittsboro, NC
N1OJH **Lambert**, Thomas, Bangor, ME
KW1Y **Cadet**, Walner, Stamford, CT
KC2AWX **Hechter**, Harvard, Fair Lawn, NJ
WB2CWJ **LeMay**, David W., Lewis Center, OH
K2EAO **Almquist**, Quentin J., East Amherst, NY
WA2EES **Doolittle**, Kim T., Newfield, NY
KB2GCV **Halick**, Michael J. "John," Jersey City, NJ
WA2HDI **Webb**, Theodore "Ted," Manchester, NJ
W2IMT **DiLorenzo**, Paul J., Penfield, NY
K2KLM **Engel**, Jack M., Mount Laurel, NJ
KA2LIM **Kent**, Kenneth E., Pine Valley, NY
•WA2MEO **Haven**, Edmond M., Delmar, NY
KC2MOW **McCue**, William M., Central Bridge, NY
KA2NDX **Jones**, Douglas W. "Wayne," Millville, NJ
WA2NRE **Flansburg**, Donald E., Buffalo, NY
K2NUD **Ryffel**, Matthew, Mahwah, NJ
WA2OUV **Brandt**, Donald R., Springfield, MO
♦K3BRS **Whiting**, R. Alfred, Silver Spring, MD
WA3DBJ **Boggs**, David R., Palo Alto, CA
K3ESU **Ulrich**, Emily, Hershey, PA
W3GKM **Young**, Steven L., Brunswick, GA
NJ3I **Matson**, Jonathan W., Jr., Easton, PA
KD3NO **Geiyer**, Ralph A., Gray, PA
N3OLP **Radcliffe**, Scott T., Laurel, MD
N3TO **Short**, Robert B. Derwood, MD
KA3UNQ **Elliott**, James C., Gambrills, MD
•KX3V **Coulter**, John L., Jr., Houston, TX
♦NQ3W **Gadbois**, George A., Sr., Silver Spring, MD
KB3WIZ **Deutsch**, Bernjamin L., Effort, PA
AE4AH **Aldridge**, Donald K., Oakboro, NC
♦WB4APR **Bruninga**, Robert E., Glen Burnie, MD
WD4AVU **Fleming**, Edgar M., Manassas, VA
♦K4BXU **Lovelace**, Thomas A. "Andy," Higganum, CT
N4CTG **Anderson**, Jeffrey L., The Villages, FL
W4DAI **Isbell**, Daryl A., Trussville, AL
•AB4ED **Hartzog**, Edgar A., Hilda, SC
W4EPI **Diggs**, Stephen S., Atlanta, GA
AG4EX **Hatterick**, Albert J., Cynthiana, KY
KM4FEY **Erlich**, Ronald H., Summerfield, FL
KA4FVG **Askew**, Larry J., Ooltewah, TN
WA4GLD **Johnson**, Donald A., Somerville, AL
W4GXL **Burns**, Charles J. "Jeff," Charlotte, NC
•KJ4HQ **Jordan**, William H., Aiken, SC
W4HXP **Simciak**, Walter C. "Bud," Jr., Melbourne, FL
N4IBS **Elliott**, Daniel I., Adrian, GA
♦♦♦W4IJY **Baker**, Carl D. "Dwight," Vero Beach, FL
•KG4JBC **Rodgers**, Eugene A., Strasburg, VA
KA4JGS **Dunn**, Jimmie J., Alexander City, AL
KD4KYM **Viehe**, George S. "Sage," Anderson, SC
♦♦♦N4LT **Wilson**, Richard D. "Dick," Ooltewah, TN
♦WB4LXP **Allsup**, Michael L., Birmingham, AL
KC4OJ **Bland**, William I., Shepherdsville, KY
KD4RQ **McGrew**, Johnny E., Sweetwater, TN
KM4SRQ **Palmer**, Douglas W., Andalusia, AL
KR4SV **Faulkner**, John R., Rocky Mount, NC
KM4TGE **Warren**, Debra L., Laurel, MS
N4TI **Tilghman**, Ralph T., Kingsport, TN
WA4U **Oppert**, Judy C., Taylor, AL
KN4UGH **Utt**, Micah D. "Mike," Lexington, NC
♦W4WJ **Murray**, Don, Fredericksburg, TX
W4WNT **Turner**, William N., Weddington, NC
KI4WSO **Buchholz**, Bettieanne B. "Ba," Palmyra, VA
W4YXU **McLester**, James B., Jr., Columbiana, AL
W5DSM **Mellor**, Dale S., Jr., Elk City, OK
NJ5DX **Hill**, James A., Lakehills, TX
KC5FCD **Wilson**, James R. "JR," Jr., Chouteau, OK
N5FJZ **Higgs**, Ray, Ida, AR
WA5FLT **Garland**, Joseph L., Calumet, OK
K5HLF **Fulford**, Hubert L., Aubrey, TX
W5JRJ **Robbins**, Johnny M., Jr., Maud, TX
KG5JWO **Hayles**, Richard L., Pearl, MS
♦K5LHO **Bowen**, Donald E., Richardson, TX
W5NTL **Lagaly**, George B., Oklahoma City, OK
♦W5OR **Reaves**, Donald E., Roland, AR
AB5PT **Cantu**, Conrado, Irving, TX
KA5RUZ **Moulton**, Ralph A., Norman, OK
WA5SJB **Farley**, Rachel R., Alamogordo, NM
K5SNA **Warner**, Larry L., Sr., Harlingen, TX
KB5TKE **Danz**, David J., Johnson City, TX
KB5VYT **Cannary**, Mark A., Austin, TX
KH6DV **Ellis**, Ronald D., Kaneohe, HI
WD6FSZ **Necas**, Roger C., El Cajon, CA
NT6G **Griffin**, George, Redwood City, CA
KD6IL **Rickmers**, David P., Canyon Country, CA
W6IYO **Clegg**, Frederick W., San Luis Obispo, CA
♦WA6JEO **Stengel**, Carl W., Goleta, CA
K6TYF **Mackinnon**, John C., San Lorenzo, CA
KA7CSP **Pugh**, Kyle, Spokane Valley, WA
KD7DJE **Johnston-Hoffman**, Dianne E., Mesa, AZ
AF7EL **Drake**, Robert R., Show Low, AZ
N7GVA **Harshbarger**, Lynn C., Ririe, ID
KF7HWU **Lucht**, Henry L., Klamath Falls, OR
KG7JEB **DeMartini**, George F., Gold Hill, OR
♦W7LFA **Ray**, Norman G., Kirkland, WA
KG7PKV **Steinhoff**, Gary A., Spring Creek, NV
W7RRH **Martini**, Richard A., Sterling, VA
KA7RYG **Patjens**, Margaret J., Gig Harbor, WA
NJ8E **Boswell**, James W., Niceville, FL
KC8GCM **Burns**, Valerie R., McArthur, OH
♦WD8H **Walcott**, Paul C., Clinton Township, MI
KE8JC **Rosenberger**, Scott L., Box Elder, SD
WD8JP **Patton**, John C., Wadsworth, OH
WA8KQQ **Waymire**, Dale E., Greenville, OH
K8NDM **Salisbury**, Dale L., Gallipolis, OH
WB8NSL **Dotson**, Charles R., Pennsboro, WV
WA8TVA **Hockensmith**, Orville L., Punta Gorda, FL
•AB8UO **Banfill**, Michael A., Hesperia, MI
♦K8VW **Winningham**, Verle D., Fenton, MI
♦WA8WHP **Sanor**, Franklin A., Beloit, OH
N8WJA **Miller**, Richard W., Breckenridge, CO
W8WL **Lamson**, William F., Papillion, NE
N8WMZ **Warren**, Danny L., West Bloomfield, MI
KC8WYY **Lingo**, Harold R., Saint Paris, OH
KA8X **Zander**, Ronald F., Las Vegas, NV
W8YNZ **Ferrero**, Douglas F., Romeo, MI
K8YSZ **Hansen**, Gary L., Harbor City, CA
•KB9AGC **Stang**, Melvin H., Glenwood City, WI
N9ARW **Lacy**, Ronald L., Hoopeston, IL
KC9CDT **Simmonds**, Lee B., Ocala, FL
N9DJC **Francisco**, William E., Sr., Decatur, IL
KA9EJL **Carver**, Jeffrey D., Murphysboro, IL
W9HTK **Goodrich**, Lawrence C., Greenfield, IN
W9IK **Leverich**, Stephen E., Danville, IL
♦WA9IXP **Frisch**, Marcus, Eau Claire, WI
K9JED **Dawson**, James E., Gallion, AL
N9JVZ **Sands**, Raymond, Sauk Village, IL
W9KAD **Drake**, Keith A., Paris, IL
N9NJW **Peak**, Janice L., Belleville, IL
N9NWO **Dean**, Gregory A., West Lafayette, IN
KB9NZY **Turner**, Richard A., Indianapolis, IN
WB9OKC **Green**, Michael D., Baileys Harbor, WI
WA9QLU **Weir**, George M., Jr., Jeffersonville, IN
♦•WB9SUG **Strickland**, Paul N., Covington, LA
K9UXC **Gharst**, Allen "Skip," Loda, IL
KQ9Z **Baker**, Donn W., Lanesville, IN
NUØB **Collins**, Kenneth W., Coffeyville, KS
♦KØDBN **Fehr**, Robert J. "Bob," Saint Louis, MO
NØEOF **Ebert**, Mark S., Park Hills, MO
♦WØIKT **Miller**, John R., Anderson, SC
KCØJCA **Spitler**, Charles F., De Soto, MO
WAØLVE **Anderson**, James E., Rapid City, SD
KØMAH **Bertelt**, Judith M., Brainerd, MN
WBØMMZ **Green**, Joseph P., Orlando, FL
♦ADØO **Weatherley**, Thomas A., III, Colorado Springs, CO
KBØWOW **Green**, Daniel R. "Smokey," Topeka, KS

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For information on how to list a Silent Key in *QST*, please visit **www.arrl.org/silent-key-submission-guidelines**.

Note: Silent Key reports must confirm the death by one of the following means: a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address, and call sign. Allow several months for the listing to appear in this column.

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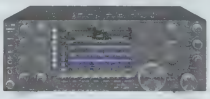

IC-7851 | *HF/50MHz Transceiver*

• 1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function • Enhanced mouse operation for spectrum scope

IC-7300 | *HF/50MHz Transceiver*

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IC-7610 | *HF/50 MHz All Mode Transceiver*

• Large 7-inch color display with high resolution real-time spectrum scope and waterfall • Independent direct sampling receivers capable of receiving two bands/two modes simultaneously

IC-R8600 | *Wideband SDR Receiver*

10 kHz to 3 GHz Super Wideband Coverage • Real-time Spectrum Scope w/Waterfall Function • Remote Control Function through IP Network or USB Cable • Decodes Digital Incl P25, NXDN™, D-STAR • SD Card Slot for Receiver Recorder

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• 160-10M** • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories

IC-705 | *HF/50/144/430 MHz All Mode Transceiver*

• RF Direct Sampling • Real-Time Spectrum Scope and Waterfall Display • Large Color Touch Screen • Supports QRP/QRPp • Bluetooth® and Wireless LAN Built-in

IC-7100 | *All Mode Transceiver*

• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions

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• VHF/VHF, UHF/UHF simultaneous receive • 50 watts of output on VHF and UHF • Optional VS-3 Bluetooth® headset • Easy-to-See large white backlight LCD • Controller attachment to the main Unit

ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch

ID-4100A | *VHF/UHF Dual Band Digital Xcvr*

• Compact, Detachable Controller for Flexible Installation • DV/FM Near Repeater Search Function • Apps for iOS™ and Android™ devices • Wireless Operation with VS-3 & UT-137 Bluetooth® Headset & Module • MicroSD Card Slot

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

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• 7W OutputPower Plus New Antenna Provides 1.5 Times More Coverage • More Audio, 1500 mW Audio Output • IP54 & MIL-STD 810G–Rugged Design Against Dust & Water • 19 Hours of Long Lasting Battery Life • 200 Memory Channels, 1 Call Channel & 6 Scan Edges

IC-R30 | *Digital/Analog Wideband Xcvr*

• 100 kHz to 3.3 GHz Super Wideband Coverage • P25 (Phase 1), NXDNTM, dPMRTM, D-STAR Mode • 2.3" Large LCD Display & Intuitive User Interface • MicroSD Card Slot for Voice & Data Storage • USB Charging & PC Connection

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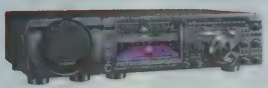

FTDX101MP | *200W HF/50MHz Transceiver*

• Hybrid SDR Configuration • Unparalleled 70 dB Max. Attenuation VC-Tune • New Generation Scope Display 3DSS • ABI (Active Band Indicator) & MPVD (Multi-Purpose VFO Outer Dial) • PC Remote Control Software to Expand the Operating Range • Includes External Power With Matching Front Speaker

FTDX10 | *HF/50MHz 100 W SDR Transceiver*

• Narrow Band and Direct Sampling SDR • Down Conversion, 9MHz IF Roofing Filters Produce Excellent Shape Factor • 5" Full-Color Touch Panel w/3D Spectrum Stream • High Speed Auto Antenna Tuner • Microphone Amplifier w/3-Stage Parametric Equalizer • Remote Operation w/optional LAN Unit (SCU-LAN10)

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Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Stable 100 Watt Output • 32-Bit IF DSP • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Output Power • Real Dual Band Operation • Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• 80 watts of RF power • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FT-818ND | *HF/6M/2M/440 All Mode Portable Xcvr*

• Ultra-Compact/Portable • 208 Memory Channels • Internal Battery Operation Capability • Two Antenna Connectors • Built-in High Stability Oscillator ±0.5 ppm

FTM-200DR | *C4FM/FM 144/430MHz Dual Band*

• 1200/9600bps APRS® Data Communications • 2" High-Res Full-Color TFT Display • High-Speed Band Scope • Advanced C4FM Digital Mode • Voice Recording Function for TX/RX

FTM-400XD | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-5DR *C4FM/FM 144/430 MHz Dual Band*

• High-Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth© Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Supports Simultaneous C4FM Digital • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FTM-6000R | *50W VHF/UHF Mobile Transceiver*

• All New User Operating Interface-E2O-III (Easy to Operate-III) • Robust Speaker Delivers 3W of Clear, Crisp Receive Audio • Detachable Front Panel Can Be Mounted in Multiple Positions • Supports Optional Bluetooth® Wireless Operation Using the SSM-BT10 or a Commercially Available Bluetooth® Headset

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Technician Class **book** for the 2022-2026 entry level exam! Gordo reorganizes the Q&A into logical topic groups for easy learning! Key words are highlighted in his explanations to help you understand the material for test success. Web addresses for more than 125 helpful, educational sites. Includes free *On the Air* mp3 download demonstrating Tech privileges. **GWTM-22 $29.95**

Tech Book & Software Package
Gordo's book with W5YI software allows you to study at your computer and take practice exams. Explanations from Gordo's book are on the software – answer a question wrong and his explanation appears to reinforce your learning. Includes free Part 97 Rule Book. **NCS-22 $39.95**

Tech Audio Course on CD
Welcome to Gordo's classroom! Technician audio theory course recorded by Gordo talks you through the Element 2 question pool. Follows the order of his *Technician Class* book, and is full of the sounds of ham radio operating excitement! An excellent study aid if you spend a lot of time in your car or pick-up! On 4 audio CDs. **GWTW-22 $34.95**

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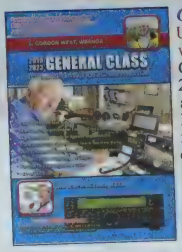

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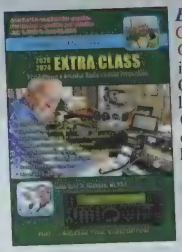

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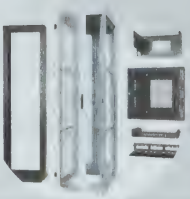

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- **Model ASC-4B**; ..... $159.00 ea.
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HAM-IV **$799.95**

For medium communications arrays up to 15 sq. ft. wind load area. 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30° F. Alloy ring gear for extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug + 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength, electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast $2^{1}/_{16}$".

HAM-VI **$1099.95** with DCU-2

HAM-VII **$1299.95** *with DCU-3*

HAM IV and HAM V Rotator Specifications	
Wind Load capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs.**

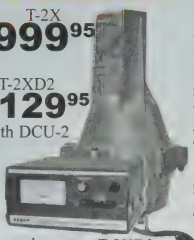
TAILTWISTER SERIES II

For large medium antenna arrays up to 20 sq. ft. wind load. 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control, triple bearing race (138 ball bearings) for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" mast.

MSHD, $159.95. Above tower heavy duty mast support. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

T-2X **$999.95**

T-2XD2 **$1129.95** with DCU-2



T-2XD3 **$1199.95** with DCU-3

TAILTWISTER Rotator Specifications	
Wind load capacity (inside tower)	20 square feet
Wind Load (w/ mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000** in.-lbs.
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

CD-45II

CD-45II **$599.95**

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45II Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

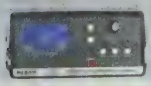
Hy-Gain Programmable DCU-3
Digital Rotator Controller
DCU-3 -- $599.95

Hy-gain DCU-3 Digital Controller lets you program 6 beam headings! Gives you full automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins *(great for older rotators with "sticky" brakes)* then turns off your motor before reaching its final heading. Your antenna *gently* coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life. Simply press *Left* and *Right* buttons for *full* manual control and fine tuning. Bright blue LCD shows current, dialed-in and computer controlled beam headings in one degree increments and your call.

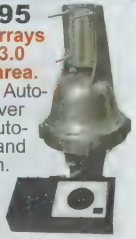
Calibrate lets you accurately match your display to your *true* beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D". 110 VAC. Order DCU-3X for 220 VAC.



DCU-2 Digital Rotator Controller --$519.95
Like DCU-3, but less programmable memories. 110 VAC. Order DCU-2X, for 220 VAC.

AR-40 -- $499.95

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area.



Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for desired location. Solid state, low voltage control, safe, silent operation. $2^{1}/_{16}$" max mast. MSLD low mast included.

AR-40 Rotator Specifications	
Wind load capacity (inside tower)	3.0 square feet
Wind Load (w/ mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

Replace your Yaesu Rotator Controller

YRC-1 - $429.95

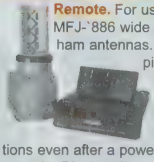
Hygain YRC-1 -- more features, more robust, far less prone to lightning damage. Costs less than repairing!

Easy-to-use -- dial in your beam heading and tap GOTO button, Exclusive 180 degree *AutoReversal*™ for fast longpath operation. All DCU-2 features. Bright blue LCD shows current, dialed-in, computer controlled beam headings, call. USB port for computer control. Extra heavy-duty AC power supply. Fast variable DC motor minimises overshoot. Intuitive menu. Field upgradeable. For Yaesu G-800/1000/2800/G450/650. AC or DC motors.

YRC-3, $519.95. Like YRC-1 and adds 6 memories.

AR-500 Rotator/Controller -- $199.95

UHF/VHF/6-Meter, MFJ-1886 Rotator/Controller and Remote. For use of small VHF/UHF/6M, TV, FM, the MFJ-1886 wide band receiving loop and other lightweight ham antennas. Rotator is built in a weather proof one piece cast aluminum housing with precision metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote, clamps, and all hardware. AR-500 remembers up to 12 directions even after a power outage! Use remote control or direct console. Displays location and relative position.



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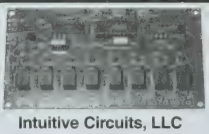

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MFJ-1979, $79.95. Premium stainless steel, 17 feet ext., 27" collapsed. Adjust length for full 1/4 wave antenna on 20-2M. Use MFJ-67 loading coil for 30/40/60/80M. For 3/8-24 standard mounts.

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MFJ-2289PKG, $369.95. BigEAR, mast, Canvas carry bag, padding, pockets, handle.

Single-band Rotatable mini Dipoles

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MFJ-1899T, $119.95. Operate 80-6 Meters/WARC bands. BNC attaches directly to your Yaesu FT-817, Elecraft KX1/2/3, Icom IC-705, Xiegu G-90, X5105. 12" loading coil with wander lead. 10-section telescopic whip, 52" ext., 7" collapsed. Whip unscrews for easy carry and storage. 25 Watts.

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MFJ Mobile HF Hamsticks

Rugged Construction. Heavy-duty 4', 3/8" diameter fiberglass base with a .125" diameter stainless steel whip. Handles 250 Watts PEP. Collapses to 4 feet for storage. 3/8x24. 75/40/30/20/17/15/10/6M. $24.95-$39.95

MFJ 10-40 Meters Portable Antenna

MFJ-1621, $149.95. 40-10M, telescoping whip: 54" extended, 22" collapsed. Tuner, field strength meter, 50' coax. 200W SSB/CW.

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MFJ-1780, $419.95. Portable 2x2 ft. Carry handle. 14-30 MHz *continuous*. 150W SSB/CW. High efficiency *true mag loop*, no rotating contact *butterfly capacitor*, all welded. Fast/slow tune remote control.

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MFJ-1918EX, $129.95. Smaller tripod with 9½' fiberglass mast. 3.8 ft. collapsed. ¾"top, 1" bottom. 6.5 lbs.

MFJ QRPocket™ Loop Tuner

MFJ-9232, $79.95. Drape a wire around a bookcase, window, tree or other and attach to this MFJ QRP Loop Antenna Tuner. It becomes a 25 Watt multi-band transmitting magnetic loop! 40-10 Meters with included flexible wire loop. No ground, radials or needed.

QRP Antenna Tuner

MFJ-9201, $74.95. *Tunes any antenna* 80-10 Meters, 25 W. 12-position hi-Q inductor, tune/bypass, antenna and transmitting matching variable capacitors, BNC connectors. Tiny 4Wx2⅝Hx 1½D inches -- MFJ-9201, rig and antennas easily fit into a backpack or briefcase for vacation, SOTA, hikes, etc.

MFJ Manual Tuner

MFJ-945E, $189.95. 1.8- 60 MHz, 300 Watts PEP. Tunes coax-fed antennas and random wires. Lighted cross-needle SWR/forward and reflected Wattmeter. Bypass switch bypasses tuner. SO-239, wing nut post for ground. Efficient, low loss airwound inductor. Small, 8Wx2Hx6D inches.

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MFJ-939, $199.95. Plug and play auto tuner for Icom, Yaesu, Kenwood and others. Automatically tunes any antenna ultra-fast! 20,000 Virtual antenna memories, matches 6-1600 Ohms, 1.8-30 MHz, 2 to 200 Watts SSB/CW. Radio interface cable included, 2-year MFJ warranty. 6½Wx1⅝Hx7½D".

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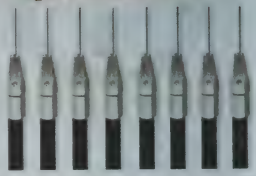

"Hamstick" style mobile antenna. Available from **6M to 75M.** Made in the USA

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Work DX and ragchew even through horrendous noise!

Pull weak signals out of static crashes, atmospheric, man-made and power line noise!

Clearly hear signals 50 KHz to 30 MHz you never knew existed. Power line noise and static just disappears.

MFJ-1886 drastically reduces noise and interference by receiving the magnetic field and rejecting the electric field. Rotate MFJ-1886 receiving loop to totally eliminate interfering signals or greatly peak desired signal.

Excellent antenna and preamplifier balance gives deep null.

State-of-the-art push-pull Gali MMICs preamp gives you high dynamic range, low IMD and 25 dB of low noise gain.

Gives excellent strong and weak signal performance without overload.

Fully protected preamplifier -- magnetically coupled voltages up to 40V and capacitively coupled voltages up to 20V will not damage preamplifier.

Output is protected from transmission line surges induced by distant lightning.

Use anywhere, inside or outside. RF signal and power goes through your 50 Ohm coax.

Ruggedly built to withstand extreme weather. 1-inch OD diameter 6061 aluminum tubing. 36-inch diameter. 2½lbs. SO-239. Use masts up to 1¾ inches.

MFJ-1886, $319.95. Includes receive loop and MFJ-4116 bias-tee to power MFJ-1886 through coax.

MFJ-1886TR, $369.95. Includes MFJ-1886 and MFJ-4113TR Bias-Tee/Transmit/Receive switch. MFJ-4113TR powers MFJ-1886 through coax and switches between transmitting antenna and receiving loop. For radios with only one antenna connector.

MFJ-4116, $54.95. Bias-Tee provides RF signal and power through coax transmission line. Send up to 1A DC up to 50 Volts.

MFJ-4113TR, $129.95. Bias-Tee with built-in Transmit/Receive switch. Switches between transmitting and receiving antenna. For radios with only one antenna connector. Provides RF signal and power through coax.

Multi-coupler/Bias-Tee

New! **MFJ-1888MC, $299.95.** Connect four receivers to one antenna. Receivers are fully isolated. Each receiver port has 1-12 dB adjustable gain. IP3 is +15 dB. 2dB noise figure. Built-in Bias-Tee powers receiving loop through coax. SO-239s. Use 12 VDC or 110 VAC with MFJ-1312D, $29.95. RF tight, 7¼Wx1¾Hx5D inches.

Super High Dynamic Range High Gain Receiving Loop

New! **MFJ-1888, $499.95.** 32 dB gain from 50 KHz to 30 MHz. 20 dB gain at 80 MHz. IP3 is + 30 dB, 1 dB compression point is 23 dB, noise figure is 1.7 dB. Built-in BCB input filters to reduce overloading. Includes MFJ-1888MC remote multi-coupler. Can be used with MFJ-4113TR Bias-Tee/T/R switch and/or MFJ-4116 bias tee. 36-inch diameter. 2½ lbs. SO-239. Use masts up to 1¾ inches.

Antenna Rotator

Perfect for MFJ-1886/1786/1788 loop, VHF/UHF, small HF beams, TV, FM antennas.

AR-500 **$199.95** **Weather-proof** one piece cast aluminum housing with precision all metal gears, steel thrust bearings and automatic braking. Includes rotator, controller, remote control, clamps, hardware. Memories for 12 directions! Digitally displays position. 110/220 VAC.

Wipe out RFI

Wipe out RFI, noise, interference from any direction at any frequency with a 60 dB notch before it gets into your receiver!

MFJ-1026 **$269.95**

Eliminate power line noise, fluorescent lamps, light dimmers, computers, TVs, lightning, motors, industrial processes.

Null out QRM on rare DX and work him! Null out local ham or AM station to prevent receiver overload. Works on SSB, AM, CW, FM, digital BCB to lower VHF. Plugs between antenna and transceiver. 12VDC, 110VAC with MFJ-1312D, $19.95.

MFJ Super High-Q™ Transmitting Loop Antennas

MFJ-1786 **$649.95**

MFJ 36-inch diameter transmitting loop antenna lets you operate 10-30 MHz continuously including WARC bands!

Ideal for limited space, HOA.

Work DX with low angle radiation and local close-in contacts with high angle radiation when mounted vertically. 150 watts.

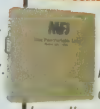
Super easy-to-use! MFJ remote control auto tunes to your desired band. Fast/slow tune buttons, Cross-Needle SWR/Watt-meter lets you quickly tune to your exact frequency. No control cable needed.

***World's** most efficient small loop antenna has all welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter aluminum radiator for highest efficiency.*

Every capacitor plate is welded for extremely low loss and polished to prevent high voltage arcing. Nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor gives smooth precision tuning. Heavy-duty ABS plastic housing has ultraviolet inhibitor.

Cover 40-15 Meters. MFJ-1788, $719.95. Like MFJ-1786 but covers 40-15 Meters continuous. Includes remote control.

Portable Loop



MFJ-1780, $419.95. *Box fan loop with carrying handle, 24x24x 5¾". 20-10 Meters continuous, 150 Watts. Fast/slow tune remote control. Highly efficient all-welded construction.*

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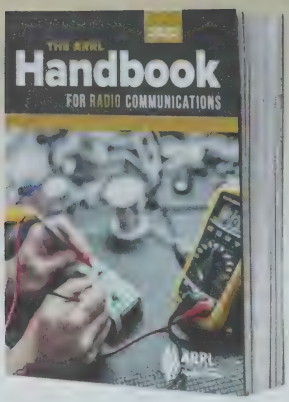

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- Solid-state amplifier linearity
- Safe practices for antenna and tower work

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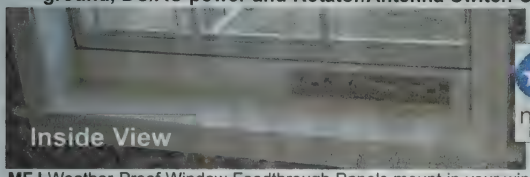
MFJ Weather-Proof Window Feedthrough Panels

Weather-proof window feedthrough panels bring HF/VHF/UHF antennas, balanced lines, random wire antennas, ground, DC/AC power and Rotator/Antenna Switch Cables into your hamshack without drilling through walls!



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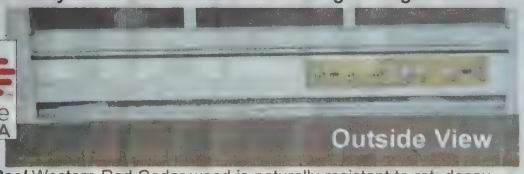
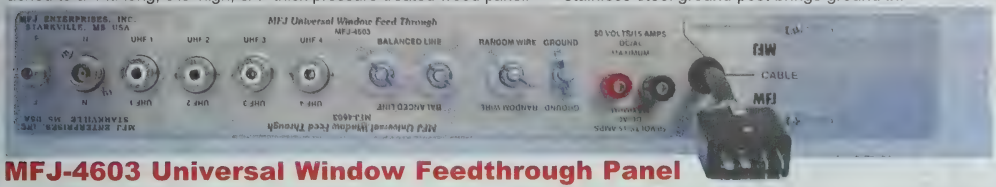


MFJ Weather-Proof Window Feedthrough Panels mount in your window sill. Lets you bring all your antenna connections into your hamshack without drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontal or vertical. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 ft. long, 3½" high, 3/4" thick pressure-treated wood panel.

Real Western Red Cedar wood is naturally resistant to rot, decay and insects -- lasts longer, maintenance free. Pitch and resin free for a wide range of beautiful finishes or leave it in its naturally beautiful raw finish. Edges sealed by weather-stripping. Seals and insulates against all weather conditions. Includes window locking rod.

Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.



MFJ-4603
$129.95

MFJ-4603 Universal Window Feedthrough Panel

Four 50 Ohm *Teflon*(R) SO-239 coax connectors let you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm *Teflon*(R) coax N-connector lets you use any antenna up to 11 GHz including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

A 75 Ohm, 1 GHz F-connector makes it easy to bring in telvision, satellite, HFD cable TV and FM radio signals.

A pair of high-voltage ceramic feedthrough insulators lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna ceramic feedthrough insulator.

5-way binding posts let you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

MFJ's exclusive *Adaptive Cable Feedthru*™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 1¼ x 1⅝ in.) Adapts to virtually any cable size. Seals out rain, snow, adverse weather.

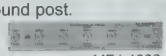
3 Coax, Balanced Line, Random Wire

Best Seller! 3 *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Separate high voltage ceramic feed-thru insulators for balanced lines and long wire/random wire. Stainless steel ground post.

MFJ-4601
$89.95

6 Coax

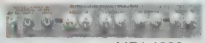
6 high quality *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watts.



MFJ-4602
$99.95

4 Balanced Line, 2 Coax

4 pairs of high-voltage ceramic feed-thru insulators for balanced lines and 2 coax connectors.



MFJ-4600
$109.95

5 Cables, any-size

5 Adaptive Cable Feedthrus™. Pass any cable with connector: 2 cables with large connectors up to 1¼x1⅝ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

MFJ-4604
$134.95

All-Purpose FeedThru/CableThru™

Stacks MFJ-4603 and MFJ-4604! Gives you every possible cable connection you'll ever need through your window without drilling holes in wall -- including UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

MFJ-4605
$199.95

Bring cables thru eave of your house

MFJ-4616 shown with vent (not included) it replaces. *Six Holes*
$49.95

MFJ-4613 shown with vent (not included) it replaces. *Three Holes*
$34.95

made in USA

Replace standard house eave/sofitt air vents with these *MFJ AdaptiveCable*™ *Plates.*

Bring in coax, rotator, antenna switch, power cables, etc. of nearly any size up to 1¼x1⅝".

Sliding plates, rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

MFJ *AdaptiveCable*™ Wall Plates

MFJ-4614
(Four Holes)
$69.95

MFJ's exclusive weather-sealed *AdaptiveCable*™ *Wall Plates* let you bring nearly any cable -- rotator, antenna switch, coax, etc. -- through walls without removing connectors. Pass cable connectors up to 1¼x1⅝". Slide plates adjust hole size to weather-seal virtually any cable. Rubber grommet seals out rain, snow, adverse weather. Kit includes 18 gauge *stainless steel* plates for wall side, sliding plates, rubber grommets, weather stripping and hardware. Models for one, two and four cables.

MFJ-4612
(Two Holes)
$49.95

MFJ-4611
(Single Hole)
$34.95

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Dummy Loads

World's most popular Dry 300 Watt HF /VHF Dummy Load

MFJ-260C
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Air-cooled, non-inductive resistor in a perforated metal housing; Has SO-239 connector. Full 300W for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz, 1.5:1 30 to 650 MHz. Compact 2¼x2¼x7 inches. **MFJ-260CN, $69.95.** With type "N" connector.

Dry 1.5 kW *HF/VHF/UHF* Dummy Load

MFJ-264
$109.95

Ham radio's most versatile 1.5 kW 50 ohm *dry* dummy load covers DC to 650 MHz. SWR 1.1:1 to 30 MHz, 1.3:1 to 650 MHz. Handles 1500W for ten seconds, 100W for 10 minutes. 3Wx 3Hx9D in. SO-239 connector. **MFJ-264N, $119.95.** With type "N" connector.

Oil-Cooled 1 kW CW, 2 kW SSB 50-Ohm VersaLoad™

MFJ-250
$109.95

Run 1KW CW or 2 KW PEP for 10 minutes. Run *continuous duty* with 200 Watts CW or 400W PEP. Transformer oil included. SWR 1.2:1 to 30 MHz. Low SWR to 400 MHz. SO-239 connector. Safety vent with cap, carrying handle. 7½Hx6⅝D in. **MFJ-250X, $89.95.** No transformer oil.

500 MHz, 100 Watt Dummy Load

MFJ-261
$44.95
With PL-259
DC to 500 MHz

Connects directly with built-in PL-259. Finned aluminum air-cooled heatsink. 15 Watts continuous, 100W peak. SWR < 1.5:1, DC-500 MHz. 1⅝ inch round by 3 inches long. **MFJ-262B, $84.95.** PL-259. 35 Watts continuous, 200W for 5-seconds. SWR< 1.2;1 DC-1 GHz.

MFJ 2500W *fan-cooled* Dry Load

MFJ-265
$279.95

MFJ's 2500 Watt *fan cooled* load handles legal limit amps, 2500W average one minute on, ten minutes off, 300W continuous. DC- 6 Meters. SWR <1.25, 30 MHz; <1.4, 30-60 MHz. Detailed power curve. 12 VDC or 110 VAC. 8¼Wx4Hx 9½D in. SO-239s. 5 pounds.

Switchable RF Dummy Load

MFJ-251
$189.95

Select 16.6, 25, 50, 100, 150 Ohm dummy loads. Test/calibrate your wattmeters, SWR accuracy. At 50 Ohms it handles 300 Watts for 30 seconds with SWR < 1.1, 60 MHz. SO-239. 4½Wx2¼Hx6½D in. Optional 12 VDC/110 VAC adaptor, MFJ-1312D, $24.95.

3 GHz, 300 Watts Dry Dummy Load

MFJ-263
$159.95

New high-tech metal film resistor on large heavy-duty air-cooled heatsink. 300 Watts for ten seconds and 125W *continuously.* SWR < 1.1, 1 GHz; <1.2, 1.5 GHz; <1.5, 3 GHz. N-connector. 10¾Wx2¼Hx5¼D inches.

1.5kW Dry DummyLoad/SWR/Wattmeter

MFJ-267
$219.95

Tune up your transceiver, linear amplifier or antenna tuner into a safe 50 Ohm dummy load at *full power.* Then instantly switch to your antenna and monitor SWR, forward and reflected power on lighted cross-needle meter. 300/3000 Watt ranges. DC-60 MHz.Test/tune Xceivers, amps, tuners, baluns, filters, coax, stubs.

SWR/Wattmeters

Compact Cross-Needle SWR/Wattmeters

MFJ-822
$84.95

Large 3-inch *lighted* Cross-Needle meter covers 1.8-200 MHz in 30/300W power ranges. Read forward, reflected power, SWR *simultaneously.* 3¼Wx3¼H x3¼D in. SO-239 connectors. **MFJ-842, $84.95.** 140-525 Mhz, 15/150W.

High-accuracy 1.8-60 MHz Digital SWR/Wattmeter

MFJ-828
$299.95

Highly accurate! Auto-ranging select 25W, 250W, 1500W ranges with *full 10-bit* resolution. Frequency compensated data insures highest accuracy. *True* peak/average forward/reflected power, SWR and frequency are *simultaneously* displayed on backlit LCD and large 3-inch lighted cross needle meter. Peak hold. LED, buzzer, amplifier-bypass alerts and protects your amplifier when SWR is high and toggles extra relay. 6½Wx2⅝Hx6D". **MFJ-826B, $229.95.** No meter, ampr bypass, control relay.

MFJ GrandMaster™ SWR/Wattmeters

MFJ-870
$119.95

GrandMaster™ SWR/Power Meters are *the Cadillacs of ham radio!* Large 3¼x1¼ inch precision illuminated meter gives easy wide-angle viewing of SWR, forward or reflected power. 7½Wx3⅛Hx4¼D in. SO-239s. **MFJ-870, $119.95.** 1.6-60 MHz. 30/300/3000 Watt ranges. **MFJ-874, $159.95.** 1.8-525 MHz. 5/20/200 Watt ranges.

MFJ *giant* 6.5 inch SWR/Wattmeter

MFJ-868B
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World's *largest* HF+6M SWR/Wattmeter has *giant* 6½ inch meter! Extra-long scales gives highly accurate SWR/power 1.8-54 MHz. Huge numbers make reading easy. *True* peak or average forward and reflected power. 20/200/2000 Watt ranges. 9 Volt battery, 12 VDC or 110 VAC with MFJ-1312D, $24.95. 7Wx5½Hx5D in. SO-239s.

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$64.95

World's most popular -- and most affordable -- VHF SWR/Wattmeter. Read SWR, forward and reflected power over 144-220 MHz in two ranges, 30/300W. Built-in field strength meter for 1-220 MHz. 4½Wx2¼Hx3D".

Compact Digital SWR/Wattmeters

MFJ-845
$139.95

Displays forward, refelected power, SWR (1.6-60 MHz) and battery *all in a single glance!* Large 1/2" forward power digits and 5/8" reflected/SWR digits! 0-200W. Power/backlight on/off. SO-239s. **MFJ-847, $129.95.** 125-525 MHz, 0-120W. **MFJ-849, $219.95.** **Large** 3.5" bright orange LCD displays SWR, forward/reflected power. 1.5-525 MHz, 200W, HF/VHF-UHF switch.

MFJ HF *QRP* SWR/Wattmeter

MFJ-813
$64.95

Read forward, reflected power 1.8-50 MHz, 0-5W. Also reads SWR, relative power 100 mW to 50W. SO-239s. 4½Wx 2¼H x3D in.

VHF/UHF SWR/Wattmeter

MFJ-862
$99.95

Lighted Cross-Needle,SWR/Watts, 144/220/440 MHz, 30/300W Forward power, 6/60W Reflected power.

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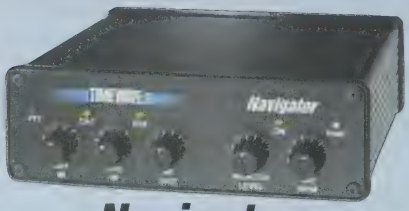
Kill Noise before it reaches your receiver! Great for supressing power line noise, plasma TV noise & many other local electrical noises.



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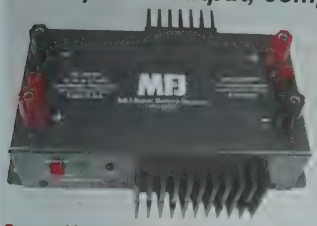
MFJ-4416C Super Battery Booster

Boost battery voltage as low as 9 Volts back up to 13.8 VDC! Keeps your transceiver at full power output, compensates for run down battery, wiring voltage drop, car off . . .



MFJ-4416C **$229.95** **Keeps** your transceiver at full power output, provides full performance, high efficiency, prevents output signal distortion and transceiver shutdown. Compensates for run-down battery, wiring voltage drop or when car is off. Provides up to 25 Amps peak with 90% efficiency. Selectable 9/10/11 Volts minimum input voltage prevents battery damage from over-discharging. RF sense turns MFJ-4416C off during receive to save power, increases efficiency and reduces noise. Adjustable 12 to 13.8 VDC output pass-through improves efficiency and lets transceiver run cooler. Has output over-voltage crowbar protection. *Anderson PowerPoles*® and high-current 5-way binding posts for DC input, regulated output. 7¾Wx4Hx2⅛D inches. **MFJ-4416BRC, $119.95.** Booster Remote Control.

Super Heavy Duty Battery Booster

MFJ-4418 **$279.95**

Super robust with heavy duty transistors, rectifier, improved switch-mode transformer, larger heatsink. Input and output EMI filters reduce noise to minimum. Rugged construction. *Power-Poles*™ and 5-way binding posts. MFJ software adjusts output voltage, measure load current, set minimum voltage level, over-current trip level, ignition control, more. External boost enable, remote input/output voltage sampling, remote controllable with MFJ-4416BRC.

RFI Filter for DC power

MFJ-1142 **$89.95**

Connects between rig and 12/ 24/50 VDC power supply/battery. Reduces RFI, hash, transients, motor noises, alternators, fuel pump whine, power windows, more! Binding posts/*PowerPoles*®.

Digital Volt/Amp Meter

MFJ-4422 **$69.95**

Connect in-line. Displays 4.5-30 VDC and up to 30A simultaneously. .01-.1V resolution. Dual .28" red/blue LED digits. *Anderson PowerPoles*™. Reverse polarity protection. 3x2x1 inches.

RFI Ferrite Chokes

MFJ-700A4 **$21.95**

Suppress RFI. Snap and locks on DC power line, coax, wires. Effectively removes RFI and noise. Install end-to-end or loop multiple turns for more suppression. .275" hole dia. 4 in package.

PowerPole™ DC Outlet Box

MFJ-1104 **$69.95**

One fused 30 Amp input and 25, 10, 5 Amp fused outputs *with Anderson PowerPoles*™. Has open fuse indicator. Sturdy metal construction, 2¾Wx3¼Hx1½D inches.

MFJ Low Pass Filter

MFJ-704 **$124.95**

High attenuation above 40 MHz. 1.5kW, 1.8-30 MHz. SWR<1.3. Nine Chebyshev poles, *Teflon*® dielectric capacitors, high-Q inductors, ground plane shielding, RF tight.

Lightning Surge Protector

MFJ-270 **$29.95**

Protect your expensive equipment from lightning induced surges on 50 Ohm coax. Use for transceivers up to 400 Watts, 1000 MHz. **MFJ-272, $44.95.** 1.5 kW.

MFJ 30-Amp Power Supply

MFJ-4230MV **$144.95**

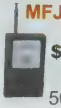
World's most compact 30 Amp switching power supply. Switchable Volt/Amp meter. Adjustable 4 to 16 VDC output. Select 120/240 VAC input. 5Wx2½Hx6D in., 3 lbs.

High-efficiency Loop Tuner

New! MFJ-935C **$299.95**

Instantly turn wire or coax into a small, high-efficiency multi-banded loop antenna. 150W, 5.3-30 MHz. Tripod/mast mount included. **MFJ-936C, $349.95.** Relative RF antenna current and Cross-needle SWR/Wattmeter. **MFJ-933C, $249.95.** Like MFJ-935C, no meter.

MFJ Field Strength Meter



MFJ-801 **$44.95**

Relative field-strength readings .1-500 MHz. Sensitivity control, 1¾ inch meter. 20-inch telescoping whip. Finger contact increases sensitivity.

Tuned Indoor Active Antenna

MFJ-1020C **$129.95**

Rival outside wire antennas hundreds of feet long and pick up signals loud and clear all over the world. 0.3-40 MHz.

25-1300 MHz Discone Ant

MFJ-1868 **$99.95**

Receives 25-1300 MHz. Transmits 50-1300 MHz up to 200 Watts. Test various X-mitters on one coax. 50 ft. coax, stainless steel elements.

17-foot Telescopic Whip

MFJ-1979 **$79.95**

17-foot stainless steel whip collapses to 27". Full 1/4 Wave on 20/17 Meters, 30-160 Meter operation with loading coil. Fits any standard 3/8-24 threaded mount.

Telescopic Fiberglass Mast

MFJ-1906HD **$269.95**

Super-strong heavy-duty mast with *QuickClamps*™. 38 ft. ext., 6 ft. collapsed. 2½" OD bottom, 1" OD top. .125" thick wall. Supports "*real*" weight.

Giant 2½ inch LED Clock

MFJ-117 **$19.95** New Low Price!

Giant 2½ inch super bright LEDs -- see from across the street day or night. 12/24 switch, 110VAC, 9V battery backup.

MFJ 2-Position *Remote* Antenna Switch

MFJ-4712 **$109.95**

MFJ 2-position *remote* antenna switch uses a *single* coaxial feedline to feed two antennas, DC power and control signals. Remotely switch HF and/or VHF antennas. Covers 1.8 MHz to 150 MHz. Handles 1500W. Impedance is 50-75 Ohms. Compact 4Wx2⅝Hx1½D". *Outside Switch Box* is fully enclosed and weather protected. Three quality *Teflon*® SO-239 connectors for transmitter, antenna one and antenna two. Stainless steel 1½" tall bracket with a U-bolt for masts up to 1½ in. O.D. *Inside biastee* control is 2¼Wx2½Hx1¼ in. Use 12 VDC or 110 VAC with MFJ-1312D, $26.95.

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MFJ-931 **$149.95**

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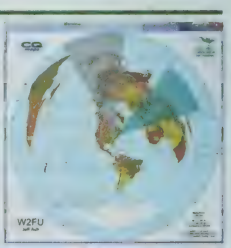

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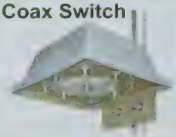

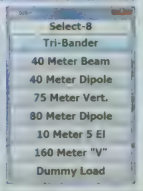

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MFJ-259D is a complete ham radio test station including frequency counter, RF signal generator, *SWR Analyzer™*, RF Resistance/Reactance Analyzer, Coax Analyzer, Capacitance/Inductance Meter and more!

Read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

Read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy-to-use! Just set the bandswitch and tune the dial -- just like your transceiver. SWR, Complex impedance displayed instantly!

Fully portable, take it anywhere -- remote sites, up towers, on DX-peditions. Use 10 AA or Ni-Cad or Ni-MH batteries (not included) or 110 VAC with MFJ-1312D, $26.95. Rugged metal cabinet, 4x2x6¾". **MFJ-249D, $329.95.**

MFJ-249D does everything MFJ-259D does with digital display only.

MFJ-269D . . . 280 KHz - 230 MHz plus 415-470 MHz, 12-bit A/D

New and improved. Now covers 280 KHz to 230 MHz and 415 to 470 MHz and 2200 Meter band!

Instantly gives you a complete picture of your antenna.

Read SWR, return loss, reflect-ion coefficient, match efficiency at any frequency simultaneously.

Read Complex Impedance (100 KHz to 230 MHz) as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp).

Determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

Coax Calculator™ calculates coax line length in feet given degrees and vice versa for any frequency, velocity factor.

Measure SWR and loss of coax with *any* characteristic impedance (280 KHz to 230 MHz) from 10 to over 600 Ohms.

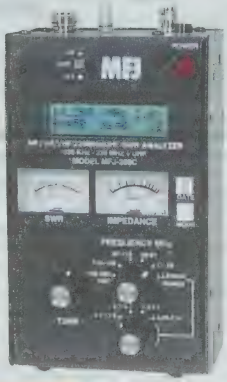
Measures inductance in uH and capacitance in pF at RF frequencies, 100 KHz to 230 MHz.

High contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

12-bit A/D converter gives much better accuracy and resolution than common 8-bits -- *MFJ-269D exclusive!*

Built-in frequency counter, battery saver, low battery warning, Ni-Mh/NiCd charge circuit. 4Wx2Dx6¾", 2 lbs. Use ten aA batteries or 110 VAC with MFJ-1312D, $26.95.

New! MFJ-269D **$449.95**



MFJ-269DPRO™ SWR Analyzer **MFJ-269DPro, $489.95.** Like MFJ-269D, but UHF range covers ***430 to 520 MHz***. For commercial work.

MFJ-223 1-60 MHz Color Graphic VNA Analyzer

MFJ-223 **$349.95**

This *pocket-sized wonder* breaks the mold for analyzer design with user-friendly convenience, top notch accuracy, and a vivid TFT multi-color display. Don't let the size fool you, it's packed with VNA features and performance you need!

- **Single-frequency** and *swept-frequency* operation
- **Truly accurate** SWR, R, X, and Z measurements
- **Seamless DDS** coverage, 100-Hz resolution from 1-60 MHz
- **Smooth "skip-free"** encoder tunes fast or slow without missing a step
- **Powerful +5-dBm** stimulus generator
- **Field-strength meter**
- **DDS generator** precision signal source
- **Vivid 1600-pixel/inch** color graphics on a 2x2 inch non-glare TFT screen

MFJ-225 1.5-180 MHz *continuous* Two-Port Graphic Analyzer

MFJ-225 **$349.95**

Out in the field, the MFJ-225 is a compact completely *self-contained handheld graphing analyzer.* On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run de-tailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, re-turn loss, phase angle, more. DDS generator.

SWR Analyzer Accessories

A. MFJ-29D/MFJ-39D, $44.95. Carrying Pouch for MFJ-259D/269D.

B. MFJ-92AA10, $44.95. 10-Pk 2500 mAh Ni-MH Supercells.

C. MFJ-66, $44.95. Dip coils, set of two covers 1.8-230 MHz.

D. MFJ-731, $134.95. Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.

E. MFJ-917, $54.95. 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.

F. MFJ-7737, $8.95. PL-259 to BNC Female.

G. MFJ-7727, $8.95. PL-259 to SMA Female.

H. MFJ-5510C, $19.95. 12VDC cigarette lighter adapter.

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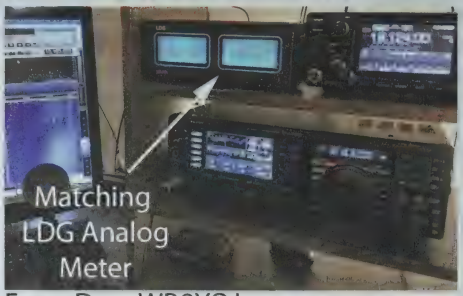
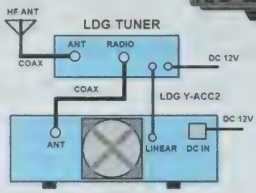


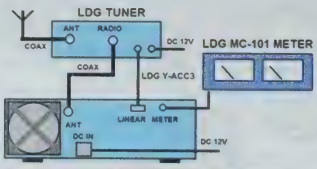
From Don, WB8YQJ

From Jeff, KA0EGE, 100Watts ID #338

As Heard On 100 WATTS & A WIRE



LDG Y-ACC2 for YAESU dx10D and dx1200



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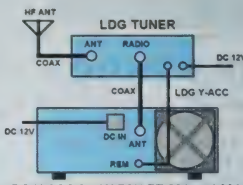

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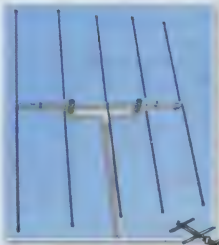

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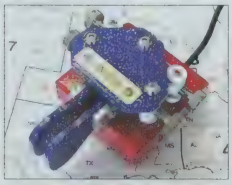

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MFJ 1500 Watt Remote Auto Tuner

Place this MFJ-998RT remote tuner at your antenna to match high SWR antennas/long coaxes -- greatly reduce losses for high efficiency

. . . Match 12-1600 Ohms, 1.5 kW, SSB/CW/Digital, 1.8-30 MHz . . . Match coax/wire antennas . . . Weather-sealed . . . Remotely powered thru coax . . . Amplifier, radio, tuner protection . . . Output static/lightning protection . . . StickyTune™ always tunes when power folds back . . . DC power jack . . .

MFJ-998RT
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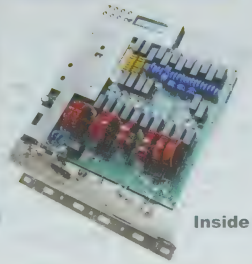


Inside View

Tune your antenna at your antenna

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed -- remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

Tuner output is static electricity and lightning induced surge protected.

MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and prevent tuning caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive StickyTune™ always tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has ceramic feed-through insulator for wire antennas. 2 kV Teflon® insulated SO-239 – prevents arcing from high SWR.

High Power, Highly Efficient

A highly efficient L-network matches 6-1600 Ohms at full 1500 Watts legal limit SSB/CW and Digital, 1.8 to 30 MHz with Hi-Q Ls, Cs.

MFJ-998RT Learns as you Operate

As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

Highly Intelligent, Ultra-fast Tuning

MFJ InstantRecall™ recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ Intelli-Tune™ measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ AdaptiveSearch™ searches only the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional **MFJ-1316, $39.95**. Weighs 9.5 lbs. 13 1/4W x 6 3/4H x 17 1/2D inches.

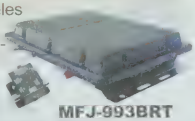
600W Remote IntelliTuner™

MFJ-994BRT – perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for outdoor use. Remotely powered through coax. Tough, durable, built-to-last cabinet, 9 1/4W x 3H x 14 1/4D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

MFJ-994BRT
$509.95

300W Remote IntelliTuner™

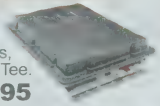
MFJ-993BRT handles 300 Watts SSB/CW and digital.Has extra-wide 6-1600 Ohm impedances. Coax/wire antennas, 1.8-30 MHz. Fully weather-sealed for remote outdoor or marine use. Remotely powered through coax. Tough, durable, built-to-last cabinet measures 9 1/4W x 3H x 14 1/4D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.



MFJ-993BRT
$389.95

200W Remote IntelliTuner™

MFJ-926B. 200 Watts SSB/CW/Digital, 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.



MFJ-926B $379.95

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160-6 Meters 43 foot Vertical Antenna

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide range MFJ automatic tuners at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up! Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $44.95**. All band ground radial system.

MFJ-2990
$399.95

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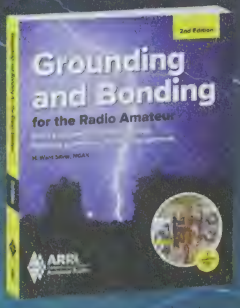

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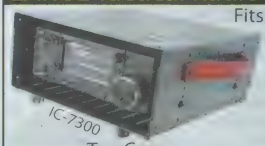

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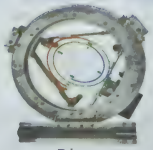

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New, Improved MFJ-989D legal limit antenna tuner gives you beter efficiency, lower losses and a new true peak reading meter. It easily handles full 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

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New, *TrueActive*™ peak reading Cross-Needle SWR/Wattmeter lets you read true peak power on all modes.

MFJ-989D, $499.95

New, high voltage current balun lets you tune balanced lines at high power with no worries.

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12⅞Wx6Hx11⅝D inches.

Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

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MFJ-986 Two Knob *Differential-T*™

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Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning fooolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 kW PEP SSB amplifier input power (1.5 kW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun, 1.8 to 30 MHz. 15Wx4½Hx10¾D".

MFJ-962D compact kW Tuner

MFJ-962D, $399.95

A few more dollars steps you up to a kW tuner for an amp later. Handles 1.5 kW PEP/SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H. *AirCore*™ roller inductor, gear-driven turns counter, peak/avg lighted Cross-needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8 to 30 MHz. 10⅞Wx14½Hx10¾D".

MFJ-969 300W Roller Inductor Tuner

MFJ-969, $299.95

Superb, *AirCore*™ roller inductor. Covers 6 Meters through 160 Meters! 300 Watts PEP SSB. Active true peak reading lighted Cross-Needle SWR/WAttmeter, *QRM-Free PreTune*™ antenna switch, dummy load, 4:1 balun, Lexan front. 10½Wx3½Hx9½D".

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More hams use MFJ-949s than any other antenna tuner in the world! Handles 300 Watts, full 1.8-30 MHz coverage, custom inductor switch, 1000V tuning capacitors, full size peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune*™, scratch proof Lexan front panel. 10⅝Wx3½Hx7D". **MFJ-948, $219.95.** Econ-omy version of MFJ-949E, less dummy load.

MFJ-941E Super Value Tuner

MFJ-941E, $199.95

Most for your money! 300 Watts PEP, 1.8-30 MHz, lighted Cross-Needle SWR/Wattmeter, 8-position antenna switch, 4:1 balun, 1000 Volt capacitors, Lexan front panel. 10½Wx2½Hx7D". **MFJ-941EK, $179.95.** Tuner Kit -- *Build your own!*

MFJ-945E HF/6M mobile Tuner

MFJ-945E, $189.95

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8Wx2Hx6D". Lighted Cross-Needle SWR/Wattmeter, Lamp and Bypass switches. Covers 1.8-30 MHz and 6-Meters. 300 Watts PEP. **MFJ-20, $13.95**, mobile mount.

MFJ-971 portable/QRP Tuner

MFJ-971, $179.95

Tunes coax, balanced lines, random wire, 1.8-30 MHz. Cross-Needle Meter, SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ rigs. Tiny 6½Wx2½Hx6D".

MFJ-901B smallest Versa Tuner

MFJ-901B, $149.95

MFJ's smallest (5Wx2Hx6D") and most affordable wide range 200 Watt PEP Versa Tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-902B Tiny Travel Tuner

MFJ-902B, $149.95

Tiny 4½Wx2¼Hx3D", full 150 Watts, 80-6 Meters, has tuner bypass switch for coax/random wire. **MFJ-904H, $199.95.** Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. 7¼Wx2¾Hx2¾D".

MFJ-16010 random wire Tuner

MFJ-16010, $104.95

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antennas. 1.8-30 MHz. 200 Watts PEP. Tiny 4Wx2Hx3D".

MFJ-9201 *QRPocket*™ Tuner

MFJ-9201, $74.95

80-10 Meters, 25 Watts. 12 position inductor, tune/bypass switch, wide-range T-network. BNCs. 4Wx2⅝Hx1½D".

MFJ-921/924 VHF/UHF Tuners

MFJ-921/924, $139.95

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8Wx2½Hx3D".

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Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $259.95.** Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

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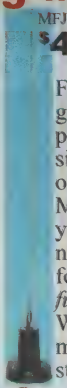
MFJ-1729 **MFJ-1729** $59.95 *Power*Gain*™ Ham Radio's most powerful dual band antenna gives whopping gain on 440 MHz and 2-Meters! Low SWR. 27½" stainless steel *Slimline*™ radiator minimizes wind vibration for less SWR flutter for longer range, better readability. 12' coax, PL-259, Heavy duty magnet mount.



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Best Seller! **These** jet-black *5-inch super strong* magnet mounts have 17' coaxial line terminated with PL-259 connectors. SO-239 (BS) or NMO (BM) for your VHF/UHF antennas or 3/8-24 threaded (BT) for your HF hamstick antennas with a 3/8-24 threaded connector.

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3-inch black magnet antenna mounts. 17 foot coax is terminated with PL-259 connector. Choose SO-239 (**BS**) or NMO (**BM**). For VHF/UHF lightweight antennas.

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Three super-strong 5-Inch Magnets make up this MFJ *Goliath*™ Tri-Magnet Mount. 1/4" thick steel triangle base. 17' coax. Select SO-239, NMO, 3/8-24 antennas. **Caution:** once on, it's difficult to get off!

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1.8-200 MHz SWR/Wattmeter

MFJ-822 1.8-200 MHz $84.95
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Compact 1.8-200 MHz SWR/Wattmeter has HUGE 3" *Cross-Needle* meter. Read forward/reflected power and SWR simultaneously. Perfect for mobile/portable. 30/300 Watt ranges. Built-in meter light. SO-239s. 3¼Wx3¼Hx3¼D". **MFJ-842, $84.95** covers 140-525 MHz, 15/150 Watts.

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A. MFJ-1402, $49.95. *VHF/UHF RuffRiderJunior*™. Premium, short 16½" antenna fits in any garage on any auto. ¼ Wave on 2 Meters, ½ Wave, gain on 440 MHz. 100W. No foldover. B or C.

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C. MFJ-1422, $54.95. *VHF/UHF RuffRider High Gain*™. 41½ inch long antenna gives extra gain with little height increase. Handles 150 Watts. ½ wave with good gain on 2 Meters, ⅝ wave, excellent gain on 440 MHz. Black or chrome.

D. MFJ-1432, $84.95. *VHF/UHF RuffRider Hyper Gain*™. 62½" brute gives whopping gain on ⅞ Wave 2-Meters, ⅝ Wave and a *MONSTER* gain on 440 MHz. MFJ will rock your ham radio world! 150 Watts. Use tri-magnet. Black or Chrome.

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$24.95 Each
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Each is ruggedly constructed. A heavy duty 4', ⅜ inch diameter fiberglass rod; a nearly indestructible .125 inch diameter PH-17-7 stainless steel whip and chrome plated brass fittings will give you years of service. It's sleek, low profile construction has low wind loading and its semi-rigid fiberglass eliminates the need for springs or guys.

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Includes allen wrench and complete tuning and matching instructions. Handle 250 Watts PEP. Whips are 7 feet fully extended, and collapse to about 4 feet for easy storage. **Simply** screws into any 3/8 x 24 female mount for quick band-changing. Get them all for great band coverage!

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Upgraded MFJ-269D has all features of MFJ-259D plus 415-470 MHz, 12-bit A/D converter, characteristic impedance 0-600 Ohms, coax calculator, parallel equivalent R/X.

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1.8-170 MHz. Plots *SWR, Impedance, Resistance, Reactance, Phase Angle, Complex Return Loss, Smith Chart.* Open-Short-Load calibration. Memories download to PC via USB.

MFJ-949E Tuner $249.95

More hams use MFJ-949E tuners than all others in the world! Large 3" cross-needle SWR/Wattmeter, 8 position antenna switch, dummy load, Match any antenna 1.8-30 MHz.

MFJ-969 Tuner $299.95

World's only 6 -160 Meters 300 Watt *AirCore*™ Roller Inductor antenna tuner gives you absolute minimum SWR. 3" cross-needle meter, true peak reading meter, dummy load, 8 pos. antenna switch.

MFJ-962D Tuner $399.95

Compact *roller inductor* antenna tuner handles popular Ameritron AL-811H/811 amps. *AirCore*™ inductor, 3" Cross-Needle meter, 6-position antenna switch, 800W SSB PEP output.

MFJ-989D Tuner $499.95

Legal-limit antenna tuner has *Air-Core*™ inductor, 500pF air variable capacitors, fast-tune crank, high voltage balun, 3" meter, dummy load, ant. switch.

MFJ-929 AutoTuner $299.95

Compact 200 Watt *IntelliTuner*™ tunes any unbalanced antenna *ultra-fast!* 20,000 Virtual Memories, Antenna Switch, Efficient L-network, Matches 6-1600 Ohms from 1.8-30 MHz.

MFJ-993B AutoTuner $349.95

Select 300 Watts (6-1600 Ohms) or 150 Watts (6-3200 Ohms) with the *world's only dual power* automatic tuner. 1.8-30 MHz, 4:1 current balun, LED lighted cross meter, backlit LCD, more!

MFJ-998 AutoTuner $769.95

Full 1500 Watts SSB/CW. Digital and analog SWR/Wattmeter, 12-1600 Ohms from 1.8-30 MHz, built-in antenna switch, auto amp bypass.

MFJ-1778 G5RV $89.95

Efficient, *all band* G5RV antenna is only 102' long, has 32.5' ladder line matching section ending in an SO-239 for feedline. Operate 80-10 Meters with tuner. 1500 Watts.

MFJ-16XX HF Sticks $17.95

Rugged, sleek **6-40M** mobile *HamTenna*™ antennas, **$24.95** each band. 250 Watts, 7' extended, collapse to about 4 feet for storage. Quickly screws into any 3/8-24 female mount for quick band changing. **60-75M, $39.95.**

MFJ-1836H Cobweb $319.95

Antenna for restricted spaces: 6-bands: 20/17/15/12/10/6 Meters. Flat 9x9x½ sq. ft. mounts horizontally on mast. Nearly invisible wire elements, fiberglass spreaders blend in sky. Withstands bad weather.

MFJ-1786 H-Q Loop $649.95

10-30 MHz Super Hi-Q loop, remote control. 36" dia. all welded construction, butterfly tuning capacitor. ABS plastic housing. **MFJ-1788, $719.95.** 7-22 MHz.

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300W VHF/HF Dry Dummy Load handles full load for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz. 1.5:1 from 30-650 MHz. **MFJ-264, $109.95.** 1.5kW load.

MFJ-1702C Ant Switch $79.95

2-position antenna switch has center ground, auto grounding of unused position, 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. SO-239 Connectors. **MFJ-1704, $129.95.** 4 positions.

MFJ-915 RFI Isolator $59.95

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents stray RF that cause painful RF "bites" and eratic operation. Heavy duty weather protected PVC is 2Wx5H inches. 1.5 kW. 1.8-30 MHz.

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High-permeability ferrite beads on high-quality RG-303 *Teflon*® coax. True 1:1 current balun/center insulator. 2" diameter by 6" long. 14 gauge stranded copper wire. Handles 1.5 kW 1.8-30 MHz.

MFJ-270 Surge Protect $34.95

Safeguard your expensive equipment. Shunts to 5000 Amps of peak impulse current harmlessly to ground. SWR less than 1.1:1, less than 0.1 dB loss. Use to 1000 MHz, 400W PEP.

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Perfect for Ham Radio and shortwave listening -- SSB, FM, AM, data and CW. Super lightweight (8 oz.) padded headband and ear cushioned design. Each earphone has own volume control. 3.5mm/1/4" plugs, 9' cord.

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World's most compact 30A switching power supply. V/A meter. 4-16 Volts, adjustable. 5Wx2½Hx6D inches, 3 pounds! Selectable input voltage 120/240 VAC.

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19.2 lb. transformer delivers 35A maximum, 30A continuous. 1-14 VDC out. 110 VAC in. Highly regulated, 1% load regulation. 1 mV Ripple. 5-way binding posts, quick connects.

MFJ-4245MV 45A PS $199.95

Switching power supply. 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7½Wx4¾Hx9D".

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Switching power supply. 75A max/70A cont. Great for ALS-500M solid state amp. Adjustable 4-16 VDC. Input 110/220 VAC. Battery charger. 10.5 lbs.

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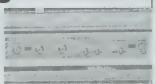
Bring your antenna cables into your hamshack without drilling holes through walls! Place in window sill, close window. *Real* western cedar 3/4" thick wood naturally resistant to rot, decay and insects, weather edge foam tape included. *Teflon*® SO-239s for HF/VHF/UHF antennas, *ceramic* feed-thrus for balanced line/random wire, ground post. Stainless steel in/out plates.



MFJ-4602, $99.95

MFJ-868B Giant Meter $199.95

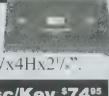
Largest HF+6M SWR/Wattmeter in the world has 6.5" diagonal scale. 20/200/2000W ranges.

MFJ-1026 Noise Cancel $269.95

Wipe out interference! 60 dB null. SSB/CW/AM/FM. BCB to lower VHF. RF sense T/R switch.

MFJ-4416C BattBoost $229.95

Keep mobile rig operational. Boosts low battery voltage. Up to 25 Amps. 7¾Wx4Hx2¼".



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Get speech fidelity you never knew existed! 3" speaker, 8W, 8 Ohms impedance, 6' cord, 3.5 mm mono.

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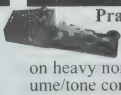

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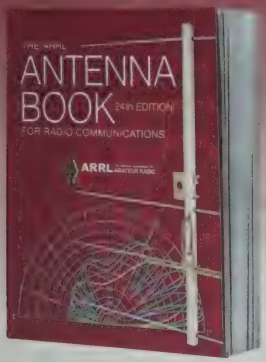

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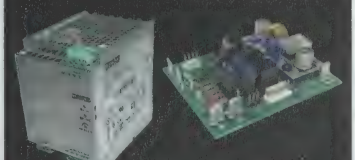

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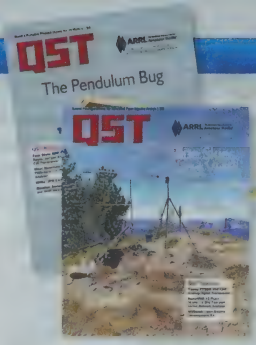

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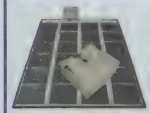

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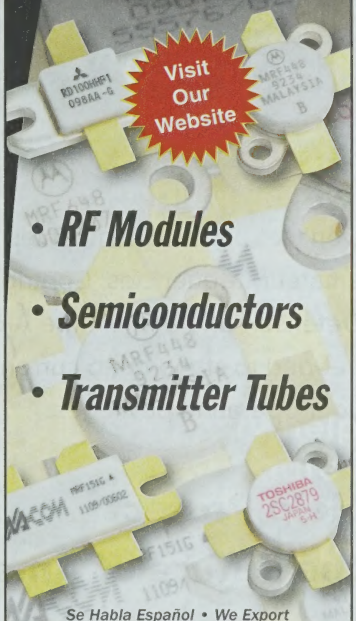

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